A star (✱) indicates that the Abstract deals with Apparatus and Instruments.

AUGUST, 1939.

GENERAL PHYSICS.

ATOMIC AND MOLECULAR STRUCTURE.

3067. Binding Energy of He^6 and Nuclear Forces. H. Margenau. *Phys. Rev.* 55. *pp.* 1173–1175, *June* 15, 1939.—A second-order perturbation calculation of the energy difference He^6–Li^6 is made with inclusion of all doubly excited oscillator states. The result, which improves the first-order energy by about 100%, alters this difference only slightly and leaves agreement with experiment, already found in first order by Feenberg and Wigner [see Abstract 413 (1937)] practically intact. Certain conclusions which may be drawn concerning the detailed nature of the spin forces are discussed. AUTHOR.

3068. Coulomb Energies and Nuclear Models. H. Brown and D. R. Inglis. *Phys. Rev.* 55. *pp.* 1182–1183, *June* 15, 1939.—Electrostatic energy differences of isobaric light nuclei, estimated by use of the α-model, do not agree with experiment as well as those given by Bethe for the central model. The comparison with experiment of the binding energies of alphas in the light $4n$-particle nuclei, given by Hafstad and Teller for the α-model [See Abstract 4735 (1938)] is improved by inclusion of the Coulomb energy. AUTHORS.

3069. Contribution of Fluctuation-Linkage to Nuclear Excitation Energy. K. Umeda. *Inst. Phys and Chem. Research, Tokyo, Sci. Papers, No.* 904. *pp.* 57-71, *June,* 1939. *In German.*—In association with Euler's calculation of the mean mass-deficit of heavy atomic nuclei [see Abstract 2877 (1937)], the author has calculated the contributions made by the kinetic energy, the Thomas-Fermi linkage and the fluctuation-linkage to the total excitation energy of atomic nuclei. The contribution of the last of these is so great that the factor by which the kinetic energy has to be multiplied in order to derive the value of the total excitation energy is considerably greater than unity, *e.g.*, 6·24 for a nucleus of mean density 2·6, and not, as suggested by Bardeen, less than unity. [See Abstract 2294 (1937).] J. S. G. T.

3070. Theory of Nuclear Structure. E. U. Condon. *Frank. Inst., J.* 227. *pp.* 801–816, *June,* 1939.—A comprehensive survey is given of the present state of the theory of nuclear structure. In particular the subjects of neutron-proton and proton-proton interaction are fully discussed. The data, on which the theory of each process is based, are outlined. β-Disintegration and the field-theory interpretation of magnetic moments are also considered. **Remarks by W. F. G. Swann** (*p.* 817.) G. O. B.

3071. Chemical Separation of Hydrogen Isotopes. L. H. Reyerson, O. Johnson and C. Bemmels. *Am. Chem. Soc., J.* 61. *pp.* 1594–1595, *June,* 1939.—A partial separation of the isotopes of hydrogen has been achieved by the action of water, containing various percentages of D on calcium carbide. AUTHORS.

3072. New Prospects in Isotope Separation. H. S. Taylor. *Nature*, 144. *pp*. 8–9, *July* 1, 1939.—A review of available methods of isotope separation and recent advances with several references. Separation by electrolysis is restricted to H, and the mass spectrograph though capable of wider application is restricted to small quantities. By diffusion, using a series of diffusion pump units, Capron and de Hemptinne obtained 50% ^{13}C from CH_4. For N, exchanging NH_3 countercurrent with NH_4^+ ion, with consequent concentration of ^{15}N at the bottom of the column, makes possible the production of 100% ^{15} N. This isotope exchange method is being extended to C, S and other elements. High speed centrifuging has been employed for Cl but is expensive. The thermal diffusion—thermal siphoning method of Clusius and Dickel is very efficient, yielding 99% ^{37}Cl in quantity : separation is carried out in vertical tubes in the axis of which is a hot surface (*e.g.*, W wire) the outside being cooled. Conditions for C are not so favourable but Joris has already raised the concentration of ^{13}C from the normal 1·1% to 2·1%, and 20% is hoped for. [See *Naturwiss*. 26. *p*. 546, *Aug*. 19, 1938.] S. J. G.

3073. Molecular Oscillators in Aromatic Molecules. F. London. *Comptes Rendus*, 208. *pp*. 2059–2061, *June* 26, 1939.—It is pointed out that aromatic molecules can be regarded as possessing properties analogous to metals whose outermost Brillouin zone is half full. The finiteness of the molecular chain has the important consequence of producing two possible types of circular polarisation in the plane of the molecule.

G. C. McV.

3074. Molecular Freedom and Melting in Alkyl Halides. W. O. Baker and C. P. Smyth. *Am. Chem. Soc., J*. 61. *pp*. 1695–1701, *July*, 1939.—Dielectric-constant and dipole-loss measurements over a range of temperature and frequency on liquid and solid *i*-propyl bromide reveal a small hindered rotational freedom of the molecules in the anisotropic molecular lattice over a 40° interval below the freezing point. Similar studies on *n*-amyl bromide show that its already-known monotropic transition, which results in a melting point (−88·7°) 5·9° higher than the freezing point, does not involve detectable rotational freedom. These results, together with measurements on *t*-butyl halides as well as other data in the literature, lead to a correlation of the melting points, heats and entropies of fusion, and liquid intervals of alkyl halides with the shapes and mobilities of their molecules in the crystals. AUTHORS.

3075. Internal Rotation and Resonance in Hydrocarbons. E. Gorin, J. Walter and H. Eyring. *Am. Chem. Soc., J*. 61. *pp*. 1876–1886, *July*, 1939.—The problem of restricted rotation about the C–C bond in ethane is discussed. It is shown that the repulsions between the H atoms cannot account for a barrier of 3000 cal. The effect of the distortion of the spherical symmetry around the C atoms by the perturbations of the H atoms is considered. It is shown that this effect tends to make the opposed form more stable but also cannot account for a barrier of the required height. The effect of resonance with double bonded structures is then considered and it is shown that with reasonable assumptions concerning the angular dependence of the exchange integrals between C orbitals, the opposed structure is the stable one with a barrier height of 0·7 to 1·9 kg.cal. If we add to this the effect of the dissymmetry of the carbons a barrier of the right order of magnitude is obtained. It is shown that this effect of resonance with double bonded structures can be used to explain the alternation in physical properties such as melting points of long chain compounds. The experimental evidence in favour of the staggered or opposed structures for long chain and cyclic compounds is discussed.

AUTHORS.

3076. Structures of Benzene, Pyridine, Pyrazine, Butadiene-1, 3, Cyclopentadiene, Furan, Pyrrole, and Thiophene. V. Schomaker and L. Pauling. *Am. Chem. Soc., J.* 61. *pp.* 1769–1780, *July*, 1939.—The re-investigation of benzene confirms the value 1·39 Å. for the C–C distance and provides a rough experimental value for the C–H distance. In pyridine and pyrazine the C–N distance is greater than expected for Kekulé resonance; the effect is attributed to extra resonance with ionic structures. The electron diffraction results, electric dipole moment data, resonance energies, chemical information, and simple theoretical considerations indicate, almost uniformly, the order furan $<$pyrrole $<$ thiophene for the degree of resonance stabilisation of these molecules. The contributions of excited structures, other than those characteristic of the conjugated double bonds, are about 10, 24, and 34%, respectively. Part of the resonance of thiophene is with structures with ten electrons in the valence shell of the S atom.

AUTHORS.

3077. Allotropes of S. Part II. S. R. Das and K. Ghosh. *Indian Journ. Phys.* 13. *pp.* 91–105, *April*, 1939.—It has been reported previously [see Abstract 3893 (1938)] that white S prepared from the hydrolysis of S_2Cl_2 possesses a new structure which is really different from those of the well-known crystalline modifications and the name S_ω was suggested for this form. The present paper describes two other methods of preparation of S_ω, namely, (i) from "chilled" liquid S and (ii) from the sublimates of S. The colour of S_ω prepared from the first method depends on the temperature of the liquid S. Thus, it is white from 119° C to 221° C and grey from 242° C to 325° C, and white again from 360° C up to the boiling point of S. In the first region the liquid is mobile, and changes to the highly viscous state in the second stage and finally becomes mobile again in the third stage. The three regions of temperature, mentioned above, are not sharply demarcated from one another. Further studies were made as to the stability of S_ω at different temperatures. It is shown that at higher temperatures insoluble S_ω converts into soluble S_a with a rate increasing with the temperature. It is suggested that a layer of SO_2 is present in the insoluble varieties of S_a and S_ω. Chemical evidences of the existence of this layer is also given. It is further suggested that under certain physical conditions which are not yet known, the SO_2 layer on crystallites is in some way responsible for the formation of the unstable S_ω variety. It has also been found that if the SO_2 layer is removed from the S_ω crystallites, it is at once converted into soluble S_α. S_ω prepared from the sublimates of S is found to be more stable than that prepared from frozen liquid S, but still its stability is of much lower order than S_ω obtained by the hydrolysis of S_2Cl_2. The structure of colloidal S particles was studied by allowing a fine beam of X-rays to pass through running drops of colloidal solution suspended in water, and it is found that the colloidal particles in water are really crystalline in character like ordinary orthorhombic sulphur (S_α).

AUTHORS.

3078. Ionic Radii and Periodic System. E. Kordes. *Zeits. f. phys. Chem.* 43. *Abt. B.* 3. *pp.* 213–228, 1939.—Simple empirical relationships are obtained connecting ionic radii, atomic numbers, and the

Born repulsion index *n*. They give good agreement between calculated ionic radii and those obtained by former methods. A. J. M.

✱3079. Molecular Weight of β-Amylose by Ultracentrifuge. C. O. Beckmann and Q. Landis. *Am. Chem. Soc., J.* 61. *pp.* 1495–1503, *June,* 1939—An air-driven ultracentrifuge of the Beams type with the optical arrangement of Lamm's refractive method of determining concentration gradients is described. The limitation of the sedimentation velocity method are discussed briefly. β-Amylose from corn starch disrupted by dry grinding for 168 hr. was found to be heterogeneous with respect to particle weight. About 50 % of the material had an average sedimentation constant of $4 \cdot 0 \times 10^{-13}$ while the values for the whole material ranged from 1·30 to over 12×10^{-13}. α-Amylose from corn starch has a sedimentation constant of the order 6000×10^{-13}. The behaviour of a light fraction of the β-amylose which precipitates and retrogrades readily is explained in terms of particle shape and hydration. AUTHORS.

3080. Molecular Weight of α-Amylo-Dextrin. C. O. Beckmann and Q. Landis. *Am. Chem. Soc., J.* 61. *pp.* 1504–1507, *June,* 1939.—The molecular weights of α-amylo dextrins prepared from substances dispersed by three different methods from the same sample of potato starch varied from 8600 to 29100. The heterogeneity of the dextrins closely paralleled that of the amylose precursors. In general they exhibited less departure from sphericity than the original amyloses. The evidence is interpreted to indicate the presence of an unattackable nucleus in the molecules of the amylose dispersion, the character of which varies widely depending upon the original methods utilised for disruption of the granule. AUTHORS.

3081. Molecular and Cybotactic Weights of Resinous and Crystalline Materials. H. L. Bender. *Am. Chem. Soc., J.* 61. *pp.* 1812–1816, *July,* 1939.—The structural group in resin solutions may be varied so easily that it seems undesirable to designate such shifting particles as chemical molecules. Nor, in fact, should their weight expressions be confused with true chemical molecular weights. The determined molecular weight numbers of a resin in solvent are shown to be changing quantities with the temporary equilibrium numerical values shifting many fold as conditions change. Any molecular weight number determined for resins is defined as an arbitrary number and considered as a cybotactic particle value, the magnitude of which value is dependent upon the conditions under which the analytical determinations are made. These measurements of what seem to be actual cybotactic particles in the resinous state change slowly in this supercooled liquid condition. The data obtained are interpreted as in line with the expectations of the cybotactic theory as applied to glassy polymers and are contrary to the expectations of the chain molecular theory of polymeric materials. AUTHOR.

3082. Probable Lengths of Hydrocarbon Chains. L. Laskowski and R. E. Burk. *J. Chem. Phys.* 7. *pp.* 465–469, *July,* 1939.—The average distance between the centre of the first and last C atoms of a freely rotating hydrocarbon has been evaluated as 1·50 *l*, where *l* is the C-C distance of 1·54 Å. This length corresponds to a spherical configuration of a thread-like molecule. A general equation for the Z coordinate of a straight chain hydrocarbon whose rotation is restricted by geometric interferences has been derived. This length is a function of the radius of the H atoms. The average Z coordinate calculated predicts that the configuration of a hydrocarbon with geometric restrictions on rotation is a statistical on whose length is greater than that calculated by Kuhn, and agrees well with the experimental estimates of Mack. AUTHORS.

3083. Formation of HeH^+ Molecules. M. B. M'Ewen and F. L. Arnot. *Roy. Soc., Proc.* 172A. *pp.* 107–115, *July* 19, 1939.—An investigation of the formation of the singly-charged helium hydride molecule HeH^+ has been made by means of a mass-spectrograph. It is found that the molecule is formed by a collision between a singly-charged hydrogen molecule and a normal helium atom in which the hydrogen molecule is dissociated. The process is $H_2^+ + He \rightarrow HeH^+ + H$. For this process to be energetically possible the colliding particles must have kinetic energy in excess of the difference between the energy of dissociation of H_2^+ (2·6 eV) and that of HeH^+, which Coulson and Duncanson find from a wave-mechanical treatment to be about 1·5 eV. The kinetic energy of the H_2^+ ion must therefore be greater than 1·1 eV. The ionisation potential of the HeH molecule is found to be 12 V. No evidence of the existence of a HeH_2^+ molecule was found. AUTHORS.

See also Abstracts 3100, 3101, 3106, 3112, 3113, 3162, 3172, 3177, 3330, 3354, 3404, 3428.

COLLOIDS.

3084. Mutual Energy of Interaction of Two Hydrophobic Particles. G. P. Dube and S. Levine. *Comptes Rendus*, 208. *pp.* 1812–1814, *June* 5, 1939.—A large number of phenomena in colloid science depend on the nature of the forces between the colloidal particles, those of repulsion being generally of electrical origin, whereas those of attraction may be of the London-van der Waals type, or electrical forces due to the presence of ionic atmospheres. Hamaker has shown qualitatively how the potential energy curves associated with two particles may be used to explain some of the characteristic properties of colloidal solutions, and a tentative theory has been proposed along these lines by Levine [see Abstract 1864 (1939)]. The authors now submit this theory in a more general form. The paper is entirely mathematical. H. H. Ho.

3085. Formation and Properties of AgBr Sols. G. H. Jonker, H. R. Kruyt and L. S. Ornstein. *K. Ned. Akad. Wet., Proc.* 42. 6. *pp.* 454–460, 1939.—A dilute AgBr sol becomes rapidly extinct. During a few hours a flocculation takes place, which slowly comes to an end, owing to increasing stability of the sol. Sols with excess of $AgNO_3$ adsorb Ag^+-ions, but finally become negative under the influence of a new double layer, the construction of which is yet unknown, on the crystal surfaces formed by internal recrystallisation. AUTHORS.

3086. Elongation and Constriction in Cell Division. G. Young. *Math. Biophysics, Bull.* 1. *pp.* 75–91, *June*, 1939.—The deformation of a constant reaction ellipsoidal cell by diffusion and constant surface tension forces is studied. The critical size of a spherical cell at which it becomes unstable to ellipsoidal deformations is found to be the same as that obtained previously by N. Rashevsky from energy considerations. It is shown that such a cell once unstable will elongate to a finite amount, and that it will tend to constrict in the centre and round up at the poles. [See Abstract 1868 (1939).] AUTHOR.

3087. Effect of Non-Electrolytes upon Setting Time of Gelatin Gels. L. Friedman and W. N. Shearer. *Am. Chem. Soc., J.* 61. *pp.* 1749–1751, *July*, 1939.—A study of the effect of non-electrolytes upon the rate of setting of gelatin gels has been carried out. Small concentrations of non-electrolytes increase setting time, this effect becoming a maximum at 0·02–0·03 molar. Concentrations of non-electrolyte exceeding 0·1 molar cause gels to set more rapidly than in the absence of non-electrolytes. Comparison with results of diffusion experiments leads to the conclusion that the slower setting gels have a more open structure.

AUTHORS.

3088. Swelling of Cellulose Fibres. W. A. Sisson and W. R. Saner. *J. Phys Chem.* 43. *pp.* 687–699, *June,* 1939.—Cellulose fibres, *e.g.*, flax, ramie, cotton, etc., either native or mercerised, if treated with a quaternary ammonium hydroxide, increase in diameter and give a new X-ray diagram from that of the original cellulose. These results are explained by ascribing a dual structure to the fibre, namely the increase in fibre diameter is due to an intercrystalline material which swells indefinitely with the reagent, whilst the change in X-ray diagram is due to the formation of a swelling compound between the reagent and the crystalline cellulose. For each reagent there is one pattern characteristic of the reacted cellulose. There is a minimum concentration below which the cellulose lattice is unaffected. The fibre swelling reaction is characteristic of the permutoid type, the swelling being accounted for by the gelatination of the intercrystalline or cementing material. The cellulose complexes from either native or mercerised cellulose or their heated modifications are completely reconverted to hydrate cellulose by washing with dilute acid and water.

S. G. B.

3089. Influence of Electrolytes on Emulsion Type and Stability. A. King and G. W. Wrzeszinski. *Faraday Soc., Trans.* 35. *pp.*741–743, *July,* 1939.—A study has been made of the effect of adding various quantities of hydrochloric acid, caustic soda, aluminium and thorium sulphates and sodium phosphate to emulsions stabilised by gum dammar, carbon black, agar, lecithin, bentonite, egg yolk, saponin, gum acacia, daxad reagents and aluminium and zinc hydroxides. In no case was phase reversal brought about and emulsion stability was generally unaffected.

AUTHORS.

3090. Electrophoretic Properties of Thymonucleic Acid. E. Stenhagen and T. Teorell. *Faraday Soc., Trans.* 35. *pp.* 743–750, *July,* 1939.—The electrophoretic mobility of pure thymonucleic acid has been investigated over the pH range 3-10. The acid is electrophoretically uniform. The course of the pH-mobility curve is similar to that of the base binding curve, proving that all ionisable groups are electrophoretically active. In spite of a large change of (apparent) viscosity with concentration, it was found that the mobility under a given potential gradient was independent of the concentration of the nucleic acid. The reason for this phenomenon is discussed. The results show that caution is necessary when attempting viscosity corrections to electrophoresis data. The electrophoretic velocity was not directly proportional to the applied potential gradient ; the mobility increased with increasing gradient. This behaviour is discussed. The effects of admixing seralbumin with the nucleic acid have been examined on the alkaline side of the isoelectric point of the protein. Some interaction was indicated by changes in the mobilities and by analysis of the electrophoretic components. It could not be decided whether real nucleoproteides were formed, or there was a kind of more physical interaction. The " carrier shift " displayed by the yellow serum pigment in the presence of nucleic acid has been commented upon. AUTHORS.

3091. X-Ray Diffraction Patterns of Hevea, Manihot and other Rubbers. G. L. Clark, S. T. Gross and W. H. Smith. *Bureau of*

Standards, J of Research, 23. *pp.* 1–5, *July,* 1939—When rubber from *Hevea brasiliensis* is stretched quickly and exposed to a beam of X-rays, a crystal fibre diffraction pattern is obtained. During previous work [see Abstract 4788 (1937)] on sol and gel fractions of this rubber, no pattern was produced by the stretched sol fraction. With the stretched gel fraction, however, the pattern was sharp and intense. Rubber from *Manihot glaziovii* also may be separated into sol and gel fractions, and in recent work they, too, have been stretched and examined by X-rays. With the stretched Manihot sol, a few interferences were obtained, but many more resulted with the stretched gel. When crystallised by "freezing" at low temperatures for 24 hr., the interferences from the gel again outnumbered those from the sol. The X-ray measurements of Manihot rubber agree with those of Hevea rubber and indicate that the same structure exists in each. Rubbers obtained from latices of *Funtumia elastica, Cryptostegia grandiflora,* and *Castilla elastica* were also examined. Their structures, too, were like that of Hevea rubber, and the similarity confirms earlier observations made when X-ray technique was less highly developed. In crystallised specimens, the crystals melted within the range of temperatures previously observed with Hevea rubber. In earlier work a large spacing was observed in a specimen of unstretched Hevea gel rubber. This spacing has been observed also in a new specimen of stretched Hevea gel rubber, together with a second spacing approximately twice as large. AUTHORS.

***3092. Methods of Synchronising Illumination for an Ultracentrifuge. Y. Björnståhl.** *Journ.Sci.Instruments,* 16. *pp.* 254–256, *Aug.,* 1939.—The ultracentrifuge makes it possible to measure the sedimentation velocity by means of optical methods while the centrifuge is running at very high speeds. If oval centrifuge rotors are used to increase the bursting strength, an intermittent light source is necessary. The light flashes must be in synchronism with the speed of the rotor. Several methods of synchronising the illumination are described. AUTHOR.

See also Abstracts 3079, 3080, 3112, 3113, 3114, 3135, 3157, 3164, 3276, 3350,
3359, 3382, 3416, and
735B. Electroosmotic Purification of Water. H. Okuno.

CRYSTAL STRUCTURE AND SPECIAL PROPERTIES.

3093. Interpretation of Laue Photographs. C. C. Murdock. *Zeits f. Krist.* 101. 3. *p.* 271, 1939. *In English.*—A correction. [See Abstract 3055 (1938).]

3094. Laue Patterns by Reflected X-Rays. D. E. Thomas. *Journ. Sci. Instruments,* 16. *pp.* 222–228, *July,* 1939.—A description of a method of obtaining Laue patterns from single crystals in sections of metal ingots and the experimental technique used for determining the orientation of the crystals.

3095. Lattice Constants of Crystallites by Electron Diffraction. H. Boochs. *Ann. d. Physik,* 35. 4. *pp.* 333–349, *June,* 1939.—In order to elucidate discordant results obtained by various workers, electron diffraction experiments were carried out to determine whether the lattice constants obtained were influenced by the size of crystallite used. For Ni a variation was found, and the relationship between lattice interval and particle size is given. For Au, however, crystallites of the order of 20 Å gave the same lattice constants as large crystallites. For ionic crystals NaCl, KCl, NaBr and LiCl, lattice constants obtained both immediately after evaporation and after exposure to air, agree to within ± 0·15% with values from X-ray determinations. Further measurements are in progress. E. E. W.

3096. Structure of $Nd(BrO_3)_3 \cdot 9H_2O$. L. Helmholz. *Am. Chem. Soc., J.* 61. *pp.* 1544–1550, *June*, 1939.—The structure of $Nd(BrO_3)_3 \cdot 9H_2O$ has been determined, and it has been found that the nine water molecules are coordinated about the rare earth ion, six at the corners of a trigonal prism and three out from the prism faces. The Nd—OH_2 distance has been found to be the same within the limits of error for all water molecules and equal to $2{\cdot}50 \pm 0{\cdot}05$ Å. The symmetry of the isolated $Nd(OH_2)_9^{+++}$ group is approximately that of D_{3h}. The space group determination gives the point group symmetry at the Nd ion C_{3v}. The Br–O separation in the bromate group has been determined to be $1{\cdot}74 \pm 0{\cdot}07$ Å., lending support to the interatomic distance reported by Hamilton, 1·78 Å., which is considerably larger than earlier published values. The existence of randomness in the crystal structure is suggested and discussed. AUTHOR.

3097. Structure of ScF_3. W. Nowacki. *Zeits. f. Krist.* 101. 4. *pp.* 273–283, 1939.—ScF_3 crystallises in the rhombohedric-pseudocubic form with lattice constants $a = 5{\cdot}667 \pm 0{\cdot}0005$, $c = 7{\cdot}017 \pm 0.0005$ Å (hexagonal axes), and $a = 4{\cdot}022 \pm 0{\cdot}004$ Å, $\alpha = 89° \, 34\frac{1}{2}'$ (rhombohedral axes) in the space group D_3^7—R32, with one molecule in the rhombohedral elementary cell. Atom positions 1 Sc = 000, 3 F = $\frac{1}{2}\, x\bar{x}/_{<})$ with $x = 0{\cdot}025$—$0{\cdot}030$. Shortest distances Sc – F = 2·02 Å (coordination number Sc → F = 6, deformed octahedral), Sc – Sc = 4·02 Å and F – F = 2·72 Å ($x = 0{\cdot}025$) to 2·70 Å ($x = 0{\cdot}030$). ScF_3 belongs to the idealised WO_3 type as already suspected by Wooster for the possibly isomorphous trifluorides of Fe, Co, Rh, and Pd. S. J. G.

3098. Structure of Gudmundite and its Bearing on Existence Field of Arsenopyrite Structural Type. M. J. Buerger. *Zeits. f. Krist.* 101. 4. *pp.* 290–316, 1939. *In English.*—Hitherto it has been impossible to investigate any member of the arsenopyrite group except in the form of a twinned complex. In this study, a member of this group. gudmundite (FeSbS) is investigated in the form of a single individual. The investigation has unequivocally confirmed the predicted monoclinic-symmetry of gudmundite with the aid of Weissenberg photographs. The nine parameters fixing the atoms of the structure have been accurately determined by trial and error computations. The resulting interatomic distances support the writer's thesis that the atomic radii in the arsenopyrite group are incompatible with the commonly accepted atomc radii. The deviations of the gudmundite parameters from the ideal marcasite-type parameters are examined in some detail and the causes of the atomic displacements giving rise to them are discussed. In the light of these discussions, some qualitative corrections to the published arsenopyrite parameter values are suggested. From the details of the arsenopyrite structural type, as revealed by the study of gudmundite, the field of existence of this structure is discussed, especially with regard to the arsenopyrite-type: cobaltite-type boundary. The mineral occurrences of these groups bear out the structural predictions. AUTHOR.

3099. Coordination of Al in Andalusite. P. C. Thornely and W. H. Taylor. *Manchester Lit. & Phil. Soc., Mem.* 83. *pp.* 17–30, 1938–1939.—That half the Al atoms in andalusite are at the centres of groups of 50 atoms [See Abstracts 472 (1930) and 1502 (1932)] is confirmed by a Fourier projection on the plane (001), as also are the octahedral AlO_6 and the tetrahedral SiO_4 groups. C. A. S.

3100. Apparent Shape of Protein Molecules. H. Neurath. *Am. Chem. Soc., J.* 61. *pp.* 1841–1844, *July,* 1939.—A method for the estimation of the relative and absolute dimensions of protein molecules from the dissymmetry constant and Perrin's diffusion equation is outlined and its limitations are discussed. The data indicate that most proteins are unsymmetric in shape. A certain regularity exists, independent of the molecular weight, when proteins are grouped on the basis of their molecular dimensions. Comparison of the dimensions of proteins with those of their respective dissociation and aggregation products indicates that cleavage occurs only in directions parallel to either the major or minor molecular axis. AUTHOR.

3101. Structure of Proteins. L. Pauling and C. Niemann. *Am. Chem. Soc., J.* 61. *pp.* 1860–1867, *July,* 1939.—It is concluded from a critical examination of the X-ray evidence and other arguments which have been proposed in support of the cyclol hypothesis of the structure of proteins that these arguments have little force. Bond energy values and heats of combustion of substances are shown to lead to the prediction that a protein with the cyclol structure would be less stable than with the polypeptide chain structure by a very large amount, about 28 kg.cal./mol. of amino acid residues; and the conclusion is drawn that proteins do not have the cyclol structure. Other arguments leading to the same conclusion are also presented. A brief discussion is given summarising the present state of the protein problem, with especial reference to polypeptide chain structures. AUTHORS.

3102. Theory of Liquid Structure. E. P. Irany. *Am. Chem. Soc., J.* 61. *pp.* 1436–1443, *June,* 1939.—True solids, *i.e.*, crystals, are distinguished by the three-dimensional fixation of their constituents; in gases no fixation or orientation of any kind exists. The structure characteristic of the liquid state must be intermediate and transitory between these two types of material constitution, but our present knowledge does not provide a unique interpretation. We are still free to construct such models of structure as may best explain the observable facts about liquids. It has been assumed that liquids are systems of two phases at equilibrium. The one, exemplified by the surface, consists of two-dimensional molecular lattice structures; the other occupies the spaces between the former in a truly gaseous condition. The equilibrium is supposed to depend on temperature but not on pressure imposed from outside. On this basis an equation of the liquid state has been formulated which contains, besides V, P and T, the dependent variables surface tension and viscosity. The three viscosity functions derived from this equation and representing it in parameter form, *viz.*, that of temperature, pressure and volume, respectively, are in very accurate agreement with measurements on a large number and variety of liquids, and thus confirm the validity of the proposed theory of liquid structure. AUTHOR.

3103. Orientation in Magnetic Field of Suspended Drop of Anisotropic Liquid. V. Naggiar. *Comptes Rendus,* 208. *pp.* 1916–1918, *June* 12, 1939.—Mesomorphic substances are usually observed between two glass plates, but purer and more constant results are obtained by suspending a small drop upon a hole pierced in a disc. Such a suspension of p-azoxyanisole in the liquid nematic state has been examined in monochromatic light between nicols when the regularity of the birefringence rings indicated a uniform inclination of the optic axis in every preparation. In a horizontal magnetic field, *i.e.*, parallel to the free surfaces, extinction is found between crossed nicols when one of the nicols has its direction parallel to the magnetic field. From the corresponding observations in the absence of a field, it follows that in this case the optic axes are all in the places parallel to the free surfaces of the drop. In a vertical field where the lines of force are perpendicular to the free surfaces, the birefringence rings disappear at a particular value and new rings are established which are more outspread and disappear at the centre of the drop for different values of the field; the optic axes are readjusted within the liquid but not so near the free surfaces. These observations are analogous with those of previous workers. H. H. Ho.

3104. Active Surface of Crystalline Powders. Part II. L. Imre. *Faraday Soc., Trans.* 35. *pp.* 751–758, *July*, 1939.—The adsorption of $Pb(NO_3)_2$ on another preparation (C) of $PbSO_4$ gave by method (*a*) [see Abstract 1919 (1937)] $z/X = 5\cdot17 \times 10^{-2}$, but by method (*b*) as previously described, values varying from $4\cdot9 \times 10^{-3}$ to $3\cdot5 \times 10^{-2}$. A revised method of calculation is described which reduces the variation to $3\cdot5$—$4\cdot6 \times 10^{-2}$. C. A. S.

3105. Reciprocal-Lattice Determination of Crystal Structure. W. F. de Jong and J. Bouman. *Zeits. f. Krist.* 101. 4. *pp.* 317–336, 1939.—A review is given of the types of crystal to which the reciprocal-lattice method of X-ray analysis can be most profitably applied [see Abstract 59 (1939)]. The necessary transformation formulæ are explained and the method is illustrated by an analysis of the structure of the mineral babingtonite. J. I.

See also Abstracts **3077, 3091, 3100, 3238, 3344, 3397, 3411, 3449.**

DENSITY.

3106. Deuterium-Protium Ratio. Part I. Densities of Natural Waters. C. H. Greene and R. J. Voskuyl. *Am. Chem. Soc., J.* 61. *pp.* 1342–1349, *June*, 1939.—Samples of tap waters, selected by various investigators as standards for the determination of the abundance of D in natural water, are shown to have the same density with a precision of $0\cdot1\,\gamma$. The importance of careful control of the isotopic fractionation incidental to the purification of samples of water is emphasised. The rôle of evaporation and fractional condensation in determining the distribution of isotopes in the waters of the earth is pointed out. AUTHORS.

See also Abstract **3361.**

DIFFUSION AND OSMOSIS.

3107. Study of Turbulent Diffusion of a Jet by Determination of Radon Concentration. J. Roquet. *Comptes Rendus*, 208. *pp.* 2011–2013, *June* 19, 1939.—The turbulent diffusion of an air jet is studied experimentally by determining the concentration, at various points in the jet, of Rn introduced into the air stream prior to its efflux through an orifice. The results are plotted as graphs having, as ordinates, the potential (V_g) attained by the indicating device and, as abscissae, the distance from the axis (x) of the experimental point at which the Rn concentration is being determined, for distances (d) of 100 cm., and 130cm. down stream from the orifice. Other curves have been determined. The results are expressible in the form $V_g = A\ (d)e^{-K^2x^2}$, and enable K, the so-called coefficient of diffusion to be determined. J. S. G. T.

3108. Diffusion of H_2 and D_2 through Fe. Part II. Glow Discharge in Mixtures of H_2 with Other Gases. A. Güntherschulze and A. Winter. *Zeits f. Physik,* 112. 11–12. *pp.* 648–653, 1939.—A continuation of previous work [see Abstract 1899 (1939)]. With only the slightest trace of O_2 the diffusion of H_2 through Fe is very much reduced. Removal of the last traces of O_2 by means of P_2O_5 in the discharge chamber raises the quantity of H_2 diffused with a kathode fall of 4500V to more than 26 cm³ Torr./mA. min. An explanation of this high value was sought. In H_2–A mixtures the diffusion with a low kathode fall increased with increased A content, considerably at first. Blockage of the Fe by A with 273V kathode fall was practically nil; with 1171V kathode fall blockage started with 55% A. and with 2157V kathode fall it started with 20% A. Similar effects were found with Ne and He. An iron plate rendered impermeable by blockage with ions of the rare gases gradually loses its impermeability in the course of tens of hours, an indication that the rare-gas ions in Fe wander extremely slowly. A. W.

3109. Self-Diffusion of Copper. J. Steigman, W. Shockley and F. C. Nix. *Phys. Rev.*56. *pp.* 13–21, *July* 1, 1939.—The self-diffusion of Cu has been measured with a radioactive isotope prepared by neutron bombardment of Zn. The isotope is electroplated in a thin layer upon the surface of a copper disc. By measuring the decrease in β-ray emission from the sample due to the penetration of the radioactive Cu, the self-diffusion constant is determined within the limits of accuracy as $11\text{cm}^2\text{./sec.}\ \exp(-57{,}200/RT)$. Methods of analysing such data are given and the significance of the variation of activation energy between self-diffusion and heterogeneous diffusion is discussed. AUTHORS.

3110. Simple Theory for Separation of Gases by Thermal Diffusion. L. J. Gillespie. *J. Chem. Phys.* 7. *pp.* 530–535, *July,* 1939. —Equations are derived in a simple manner by equating the net bombardment of each species across a plane between two adjacent thin layers of the gas mixture to the amount of each species returned across the plane by a return flow which flow is assumed necessary to keep the pressure constant and is assumed to carry back the various species in the proportions in which they exist in the neighbourhood. The average temperatures of the layers differ by dT, but the bombardment of each species is assumed independent and calculable in any layer in the way the pressure of an ideal gas at constant temperature is calculated. The resulting equation for binary mixtures does better than give the order of magnitude of the observed separations. It appears to give an upper limit, either in agreement with data or somewhat higher—up to about twice the observed value—and to fit data somewhat better than does the approximate equation of Chapman. The agreement is poorest for mixtures containing hydrogen and also whenever the lower temperature is extremely low. The equations for mixtures of any number of species are simple. They indicate that the separation of two heavier species should be improved by addition of a light gas. An attempt to improve the equations by introduction of mean free paths is found profitless, unless arbitrary values are to be chosen.

AUTHOR.

3111. Thermal Diffusion in Mixtures of Inert Gases. B. E. Atkins, R. E. Bastick and T. L. Ibbs. *Roy.Soc., Proc.* 172*A. pp.* 142–

158, *July* 19, 1939.—Measurements of thermal separation have been made in all the binary mixtures of He, Ne, A, Kr and Xe ; using the Shakespear hot-wire method of gas analysis. By applying Chapman's theory the repulsive force index S_{12} of the intermolecular field has been obtained for each pair. The results show a wide and orderly range of molecular behaviour, the values of S_{12} extending from 11·4 for He-Ne to 5·3 forKr-Xe. In all cases there is a decrease in the value of S_{12} as a heavier molecule is substituted for a lighter one in a mixture. The successive monatomic molecules thus become " softer " as their mass increases, *i.e.* their behaviour becomes less like that of rigid elastic spheres. This conclusion is in general agreement with the information given by viscosity on the molecular fields of the single gases. A comparison with Harrison's thermal diffusion value of S_{12} for He-Rn, obtained by using radioactive methods of measurement shows that the massive Rn molecule takes its proper place in the sequence as the " softest " of the group. AUTHORS.

3112. Diffusion Velocity and Molecular Weight. Part I. Limits of Validity of Stokes-Einstein Diffusion Equation. L. Friedman and P. G. Carpenter. *Am. Chem. Soc., J.* 61. *pp.* 1745–1747, *July,* 1939.—It has been shown that molecular weights of simple non-electrolytes can be calculated from diffusion coefficients determined at infinite dilution, (1) by an examination of the values of diffusion coefficient to be found in the " International Critical Tables," and (2) by experimental study of the diffusion velocity of glucose. [See following Abstract.] AUTHORS.

3113. Diffusion Velocity and Molecular Weight. Part II. Effect of *p*H upon Particle Size in Gelatin Solutions. L. Friedman and K. Klemm. *Am. Chem. Soc., J.* 61. *pp.* 1747–1749, *July,* 1939.—The effect of pH upon diffusion velocity of gelatin solutions has been measured over the pH range 0.05 to 6.4. The effect of added KCl at the various pH's upon the diffusion coefficient has been measured. Results obtained indicate that between pH's 2 and 6.4 only a small change in particle size takes place in 3% gelatin solution at 35°, but below pH 2, there is a rapid decrease in particle size. [See preceding Abstract.] AUTHORS.

3114. Osmosis and Swelling and their Biological Importance. E. Ernst. *Kolloid Zeits.* 87. *pp.* 276–280, *June,* 1939.—Osmotic and swelling phenomena are very fully described and discussed in the light of a new method of formulation. Its advantages are illustrated by numerous biological examples. H. H. Ho.

3115. Osmotic Pressure of Aqueous Solutions of Polybasic Acids and their Salts. W. Kern. *Zeits f. phys. Chem.* 184. *Abt.A.* 3. *pp.* 197–210 *and* 184. *Abt.A.* 4. *pp.* 302–308, 1939.—Osmotic pressure measurements are carried out on aqueous solutions of a polyacrylic acid (degree of polymerisation about 340) in presence of various concentrations of alkali. As the alkali concentration is increased the osmotic pressure falls more and more below that calculated for the monovalent kation. There is thus a " buffering " or " electrostatic deactivation " of the osmotic activity of the monovalent kation by the macromolecular polyvalent anions. The so-called " osmotic dissociation curves " of the salts of such polybasic acids are shown to be analogous to the dissociation curves of monobasic acids. The effect is formulated and reference is made to its probable biological significance. It is dependent to a small degree upon the size of the kation (salts of alkalis and amines are investigated) and to a great degree upon their valency. The osmotic dissociation curve for the case of divalent kations differs markedly from that for monovalent kations.

L. A. W.

See also Abstract 3086 and

11B. Diffusion of Mg in Al. W. Bungardt and F. Bollenrath.

ELASTICITY AND PLASTICITY.

3116. Numerical and Graphical Method of Solving Two-Dimensional Stress Problems. H. Poritsky, H. D. Snively and C. R. Wylie, Jr. *J. of Applied Mechanics*, 6. *A*63–*A*66, *June*, 1939.—In developing this numerical and graphical method for solving two-dimensional stress problems, while the authors use a tension members with a semicircular notch as an example, the procedure actually has a wide range of application. Comparison of the calculated results and those obtained from photoelasticity shows close agreement. The maximum value of the stress in the plate used as an example obtained by this method is 3·25. This compares with a maximum of 3·20 obtained photoelastically by Wahl and Beeuwkes and a maximum of 3·05 obtained in the same manner by M. M. Frocht. AUTHORS.

3117. Calculation of Energy Losses During Impact. C. Zener and H. Feshbach. *J. of Applied Mechanics*, 6. *A*67–*A*70, *June*, 1939.—When an elastic sphere collides with another perfectly elastic body, part of the initial kinetic energy is lost in starting elastic waves in the two bodies. The energy thus dissipated can be calculated by previous analytical methods only when it is a small fraction of the initial kinetic energy. This paper develops an approximate analytical method for this calculation which is applicable even when the greater part of the energy is dissipated. Thus in a particular case where the energy dissipated is 90 % of the original kinetic energy, an error of only 0·7 % is made. The new element in this analysis is the introduction of a " normalised " interaction force which is necessarily quite insensitive to one's ignorance of the exact interaction force. The powerfulness of the method is illustrated by a complete survey of the problem of impact of spheres with beams fixed at each end. Graphs are constructed showing the variation of the coefficient of restitution with the length of the beam and the mass of the sphere. Impacts with multiple blows are excluded. It is found that when the mass of the sphere is kept constant, the coefficient of restitution has a minimum for a certain optimal beam length, and is independent of the beam length for values greater than twice the optimal length. The coefficient is a minimum when the period of the fundamental mode of vibration is approximately equal to 2·4 times the time of contact. The method is also applied to the impact of spheres with large thin plates. The semi-empirical formula of Raman is derived. Although this analytical method cannot be applied to impacts with multiple blows, it nevertheless gives the conditions for such multiple blows. AUTHORS.

3118. Flexure and Torsion of Beam of Limacon Cross-Section. D. L. Holl and D. H. Rock. *Zeits. f. angew. Math. u. Mechanik*, 19. *pp.* 141–145, *June*, 1939. *In English.*

3119. Bending of Thick Plates under Specified Conditions of Support. J. Morrow. *Phil. Mag.* 28. *pp.* 73–80, *July*, 1939.—In the discussion of the thick rectangular plate under uniform transverse load and with clamped edges, it is usually assumed that, in the unstressed state, the middle surface of the plate is plane, and the support is such that, in the strained state, the edges of the middle surface remain in the same plane. In the present paper, the four corners of the middle surface are considered to remain in the original plane, and the supports are shaped to permit slight bending of the plate at the edges in such a way that the linear intensity of pressure on the supports is uniform along each edge of the rectangle. The case examined mathematically in detail is that of a rectangular plate of uniform thickness supported and clamped so that one-quarter of the total load is borne at each edge. Solutions are derived for the cases in which expansion of the middle plane is, or is not, permitted. J. S. G. T.

3120. Mechanical Properties of Pd containing H_2 at Various Temperatures. H. Jungnitz. *Zeits. f. techn. Physik*, 20. 6. *pp.* 161–169, 1939.—It is found that that in Pd with occluded H_2 the decrease of ultimate strength with temperature takes place more rapidly than with the pure metal, while ductility increases; this is attributed to easier recovery from cold work in the case of the modified lattice structure of the alloy. The initial rise of tenacity with H-content, previously reported for room-temperature [see Abstract 4506 (1936)] has already disappeared at 52° C. at which tenacity immediately drops with H-addition. Tenacity /composition plots at various temperatures are parallel, and, except for small H_2-contents, linear. From X-ray lattice data, it appears that α and γ phases are present simultaneously at different spots, probably the latter is more distorted by H_2 than the former, and there is no evidence for PdH_2 On electrolytic charging with H_2, the Pd surface becomes buckled, dull, porous and cracked. D. R. H.

3121. Relation between Elastic Constants for Artificial Stone. R. H. Evans. *Leeds Philosoph. and Lit. Sci., Proc.* 3. *pp.* 569–575, *May*, 1939.—The relation between modulus of elasticity, Poisson's ratio and modulus of rigidity for artificial stone is investigated by experiments on a number of concrete columns of 1 : 1 : 2, 1 : 2 : 3, and 1 : 3 : 5 mix. Each column is tested under repeated loads in tension, compression and torsion, the maximum stress applied being limited in tension and torsion by the tensile strength of the concrete. Observations are taken of the longitudinal and transverse strains in tension and compression and of the angle of twist in torsion. From a consideration of the strains for increasing loads, which are found to be sensibly linear, it is shown that the actual modulus of rigidity agrees very satisfactorily with that calculated from the equation $E = 2N(1 + 1/m)$ after substituting the observed values of E and $1/m$ from either the tension or compression tests. AUTHOR.

3122. Plastic-Elastic State. K. Bennewitz and H. Rötger. *Phys. Zeits.* 40. *pp.* 416–428, *June* 15, 1939.—This theoretical paper continues the earlier work of the authors [see Abstracts 5030 (1936) and 1023 (1939)], in which the mechanical damping of a solid was represented by a process of equalisation of energy. The equalisation of matter by diffusion is now considered. A body is regarded as consisting of n types of elements differing in elastic and plastic properties instead of a rigid framework with an interpenetrating plastic medium. Four possible practical cases are developed :—Deformation under constant external force neglecting inertia, free and forced vibrations, a constant external force allowing for inertia (the velocity of fall of a sphere in a medium). On the basis of the constants derived a preliminary classification of plastic-elastic substances is indicated. J. B. W.

3123. Calculation of Stresses Within the Boundary of Photoelastic Models. R. Weller and G. H. Shortley. *J. of Applied Mechanics*, 6. *A*71–*A*78, *June*, 1939.—A method is proposed for the determination of the internal stresses in a two-dimensional system from data furnished by a photoelastic analysis. The method involves the numerical integration of the Laplace difference equation over a region with known boundary values by the iteration of a set of improvement formulae. The underlying theory is discussed briefly, reference being made to a more mathematical treatment appearing in another paper by the authors [see Abstract 2703 (1938)]. New procedures for increasing the speed and accuracy of such computations are described and application is made to a typical photoelastic study. In this the complete system of internal stresses is computed, using the data obtained from the usual fringe photograph, without recourse to isoclinic lines, or other supplementary experimental measurements. The method is also applicable to other problems of potential theory which involve the vanishing of the Laplacian. This includes electric fields, steady-state heat conduction, shapes of membranes, and problems in hydrodynamics and gravitation. AUTHORS.

***3124. Artificial Quarter-Wave Plate for Photoelasticity, and its Theory. Z. Tuzi and H. Oosima.** *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 905. *pp.* 72–81, *June*, 1939. *In English.*—Cellophane sheets are suitable for the construction of quarter-wave plates for use with Polaroid sheets in the study of photoelasticity. The theory of quarter-wave plates constructed of cellophane is discussed. J. S. G. T.

3125. Oscillations of Cylindrical Shell. H. Egger. *Akad. Wiss. Wien, Ber.* 147. 2*a*. 7–8. *pp*. 293–334, 1938.—Starting from the strict equations for circular cylinders, the frequencies of axially symmetrical oscillations are worked out for shells with the ends (*a*) flexibly supported, and (*b*) rigidly supported. For a definite ratio of thickness of shell to mean radius, and for four ratios of length of cylinder to diameter, the frequencies are determined both for symmetrical and anti-symmetrical oscillations. The effect of the different end conditions on the magnitudes of the roots of the frequency equations is small, making a difference of only 1·35 % for symmetrical, and 2·54 % for antisymmetrical fundamental frequencies, when the height is equal to the diameter. For long thin cylinders the theory of purely dilatational oscillations is a very good approximation. The effect of different thicknesses is investigated by an approximate method. J. P. A.

3126. Increase of Tensile Strength of Fused Quartz with Increased Temperature. W. Dawihl and W. Rix. *Zeits. f. Physik*, 112. 11–12. *pp*. 654–666, 1939.—It has previously been found [see Abstract 4779 (1938)] that at 800° C the tensile strength of fused quartz is about $\frac{1}{3}$ greater than at room temperature. Further investigation shows that the previous heat treatment of the fused quartz has a considerable effect on its tensile strength at room temperature. From −60° C to room temperature there is a marked decrease of tensile strength with rise of temperature. Between room temperature and 500° C tests were not carried out, but at 500° C the tensile strength is only slightly greater than at room temperature, while above 500° C there is a marked increase of tensile strength. Discussion of the results leads to the conclusion that the observed increase between room temperature and 800° C is attributable to transformation effects in the residual crystals present in the fused quartz, analogous to the change from the α to the β type of quartz crystal. A. W.

See also Abstracts

64B.	Electric Strain Gauge. M. A. Rusher and A. V. Mershon.
260B.	Plastometry of Synthetic Resins. R. Houwink and P. N. Heinze.
718B.	Tensile Strength and Ductility of Light Al-Mg-Si Alloys. W. Geller.
728B.	Apparatus for Photoelastic Experiments in Pure Torque. P. M. Gilet.
745B.	Mechanical Characteristics of Rubber. F. L. Haushalter.
1377B.	Electric Strain Gauge. M. A. Rusher and J. W. Matthews.

GRAVITATION.

3127. Gravity Anomalies. S. v. Thyssen and F. Lubiger. *Beitr. z. angew. Geophys.* 7. 4. *pp.* 366–391, 1939.—In order to examine the difference between a theoretically calculated and a measured gravity anomaly the gravity effect of a small valley was calculated and also measured by a Thyssen gravimeter. Three theoretical solutions gave satisfactory results and are in accordance with the gravimetric measurements. W. A. R.

***3128. Static Gravimeter for Measurements on Land and Sea. Parts II and III. H. Haalck.** *Beitr. z. angew. Geophys.* 7. 4. *pp.* 392–447, 1939.—The various sources of error, their extent and the means of avoiding them in the use of the instrument are discussed in detail. Then follows a similarly detailed account of its use on board ship, and in particular as regards the mode of suspension. It is concluded, as a result of actual observations, that on board a large ship in a calm or moderate sea, an accuracy of ± 3–5 mgal. is obtainable. [For Part I see Abstract 4322 (1938)]. C. A. S.

HYDRODYNAMICS AND AERODYNAMICS.

3129. Gas Jets from Rectangular Orifices. D. Riabouchinsky. *Comptes Rendus,* 208. *pp.* 1765–1767, *June* 5, 1939.—The form of a gas jet issuing from an orifice which is either square or approximately square in section is discussed mathematically by the method developed in previous papers [see Abstracts 801 and 1427 (1938)]. The distribution of pressure in the jet is briefly mentioned. Experimental confirmation of the form of the jet issuing from an orifice of square section has been obtained. J. S. G. T.

3130. Permanent Motion of Currents at a Free Surface. F. Paderi. *Ricerche di Ingegneria,* 7. *pp.* 58–66, *April,* 1939.—Starting from Bernoulli's theorem for a perfect fluid and considering a semi-pefect current, the fundamental characteristics of gradual permanent motion and the differential equations that such motion must satisfy can be determined. In particular, considering a slow current and evaluating pressure losses, actual conditions can be realised by adding a new coefficient in addition to that for uniform motion. W. A. R.

3131. Theory of Velocity Field for Laminar Flow. H. Petersen. *Zeits. f. Physik,* 113. 1–2. *pp.* 134–139, 1939.—A method is now described, without the aid of the Prandtl boundary-layer theory, for the evaluation of the velocity field formed when a thin plate is immersed in a laminar liquid or gaseous flow. The undisturbed flow should be parallel to the length of the plate. It is noteworthy that the results are in agreement with the Blasius resistance law. H. H. Ho.

3132. Boundary-Layer Profile for Given Pressure Distribution. H. Görtler. *Zeits. f. angew. Math. u. Mechanik,* 19. *pp.* 129–140, *June,* 1939.—The considerations now advanced are an addition to a recent publication by Prandtl [see Abstract 1431 (1938)] on boundary-layer calculations. §1 contains a general description of the procedure; §2 gives a detailed application of the method for special cases; §3 discusses the Blasius-Hiemenz solution for a right circular cylinder immersed in a uniform stream; §4 considers the introduction of dimensionless magnitudes; §5 briefly states the validity limits of the Blasius-Hiemenz solution, and §6 and §7 contain the results of the calculations. The process now used is found to be very serviceable and affords boundary-layer data to a considerable degree of accuracy. An appendix deals with special numerical cases. H. H. Ho.

3133. Resolution of Liquid Jet into Drops. G. Littaye. *Comptes Rendus*, 208. *pp.* 1705–1707, *May* 30, 1939.—The breaking up of a liquid jet into drops is examined by illuminating the jet from a point source of light, and placing a photographic plate at some distance behind the jet. It is shown that oscillation of a jet occurs only when the flow of the liquid in the tube is turbulent. S. W.

See also Abstract 3107, and

286B. Flow Measurements. T. Schiel.
512B. Magnetic Flowmeter. W. M. Lansford.
1553B. Flow in Large Pipes, Conduits, Tunnels, Bends and Siphons. J. Williamson.

KINETIC THEORY OF MATTER.

See Abstracts 3110, 3111, 3293, 3294, 3477.

LENGTH, AREA AND VOLUME.

3134. Permanence of Standards of Length. R. H. Field. *Canad. J. of Research*, 17. *Sect. A. pp.* 71–76, *May*, 1939.—A few reasons are presented for believing that the fundamental standards for the metre and the yard, and also the legal Dominion standards of length, are not changing appreciably. On the other hand, measurements of a number of laboratory nickel-iron rules show progressive shortening which is still taking place, through periods up to 20 years. AUTHOR.

***3135. Sub-Screen Particle Size Measurements. E. I. Shobert II.** *Rev. Sci. Instruments*, 10. *pp.* 169–173, *June*, 1939.—The apparatus originally described by Wiegner for measuring sub-screen particle sizes is discussed with respect to its applications to various ranges of materials and particle sizes. A method of simplifying the calculation of particle size from the sedimentation curves is discussed which is particularly adapted to powder analysis in connection with powder metallurgy. Methods are described of applying the sedimentation method to regions where Stokes' law no longer holds. AUTHOR.

***3136. Dividing and Ruling Scales. R. P. Abraham.** *Journ. Sci. Instruments*, 16. *pp.* 205–209, *July*, 1939.—A general outline is given of modern methods of producing ruled scales, either singly or in quantity, on metal, glass, wood or celluloid. The important elements of a dividing machine are discussed together with the provisions necessary to reduce or compensate for errors. Reference is also made to those scales, reproduced on glass by photographic means, which are now commonly employed as graticules in optical instruments. H. B.

See also Abstract 3272, and

1612B. Electrical Measurement of Small Variations in Length. E. Froböse and K. Schönbacher.

MATHEMATICAL METHODS AND THEORY OF MEASUREMENTS.

3137. Integration of Partial Differential Equations in Heat and Fluid Mechanics. P. Vernotte. *Comptes Rendus*, 208. *pp.* 1712–1713, *May* 30, 1939.—The author has previously discussed the solution of the classical equation of heat propagation in the form of a series $V = f(z^2 : x)$. A more general type of solution $f(z^m : x)$ is now discussed very briefly. The heating of a disc rotating in a fluid, and the problem of the limiting layer in the flow of fluid along a plane are referred to. J. S. G.T.

3138. Huygens-Kirchhoff Principle for Dimensional Numbers. P.O. Müller. *Phys. Zeits.* 40. *pp.* 428–435, *June* 15, 1939.—An alternative method is now described to that of V. Volterra, on the vibrations of isotropic elastic bodies, whereby the Huygens-Kirchhoff principle is generalised for any dimensional order. The paper, which is entirely mathematical, is divided into five sections, *viz.* (1) Derivation of the Huygens-Kirchhoff principle for strictly monochromatic waves. (2) Space of even order in which only the amplitude equation is considered. (3) Space of odd order. Here a somewhat altered form of the formula enables a physical interpretation to be derived which is in agreement with the original considerations of Huygens and Fresnel. (4) Generalisation of the principle for strictly harmonic waves to any kind of wave by the aid of Fourier series or Fourier integrals. (5) The Huygens-Kirchhoff principle in space of the first order R_1. H. H. Ho.

***3139. Integraph for Solution of Differential Equations of Second Order. D. M. Myers.** *Journ. Sci. Instruments*, 16. *pp.* 209–222, *July*, 1939.—An integraph has been developed for the solution of differential equations of the first or second order. It is an instrument of the rolling type, in which all the variables of the equation are represented by the linear displacement of mechanical links. For given initial conditions, the instrument provides the solution of a given equation in the form of two curves, representing respectively the dependent variable and its first derivative. AUTHOR.

***3140. Improved Disposition for Mirror, Pointer and Scale in Precision Instruments. G. O. Forester.** *Journ. Sci. Instruments*, 16. *pp.* 268–269, *Aug.*, 1939.—An arrangement of the mirror, pointer and scale of a precision instrument is described in which an image of the scale is co-planar with the pointer. This makes it possible to use a magnifying lens or telescope or to attach a vernier to the tip of the pointer. AUTHOR.

See also Abstracts 3116, 3123, 3145, 3425.

MECHANICS, CLASSICAL.

3141. Secondary Problem of External Ballistics. G. Garcia. *Comptes Rendus*, 208. *pp.* 1707–1709, *May* 30, 1939.—The effects of the curvature of the earth, and the variations of density and of gravity with height on the path of a projectile are considered, and the methods of Poincaré and Picard used to obtain a solution of the problem to the desired approximation. [See Abstract 530 (1939).] S. W.

3142. Frictional Collisions of Imperfectly Elastic Bodies. G. Boulanger. *Comptes Rendus*, 208. *pp.* 1787–1789, *June* 9, 1939.—In the discussion of frictional collisions two difficulties arise, (a) to give a precise condition for the final instant of collision, and (b) to give a precise meaning to the idea of coefficient of restitution. In this mathematical note, it is assumed that, for a system consisting of two bodies in collision, a fraction e^2 of the kinetic energy absorbed during compression is restored during relaxation, and the collision is stated to end when the work done by the normal reaction during relaxation has restored just this fraction of energy. e is the coefficient of restitution and is a function not only of the individual coefficients of restitution of the two bodies in collision, but also of the motions during collision. The coefficient e is calculated by taking account of the amounts of energy absorbed by both bodies during compression. S. W.

3143. Resistance to Motion of a Body Moving in a Tube. G. Luneau. *Comptes Rendus*, 208. *pp.* 1876–1878, *June* 12, 1939.—The moving body is a plate of approximately the same area, S. as the cross-section of the tube, of length l, filled with fluid of density ρ, in which it moves with velocity V, being attached to the bottom of a heavy pendulum, which swings through amplitude c with period T,. The energy E expended per complete period is thence calculated as $\pi^2 c\mathrm{S}/\mathrm{T}\ (32 + l)$. E thus determined agrees within 10% with its value determined experimentally from the reduction in the amplitude of the pendulum. C. A. S.

MECHANICS, QUANTUM.

3144. Reducible Case in Wave Mechanics for Particles with Spin 1. L. de Broglie. *Comptes Rendus*, 208. *pp.* 1697–1700, *May* 30, 1939.—The author shows that his equations for the photon are analysable into a set similar to Maxwell's equations and into a second "non-Maxwellian" set. It is shown that the square of the spin-operator has proper values of the form $j(j+1)$ and that both the cases $j = 1$ and $j = 0$ are possible even if the non-Maxwellian equations are omitted from the scheme. G. C. McV.

3145. Properties of the Bicharacteristic Lines of de Donder's Equation. G. Biben. *Comptes Rendus*, 208. *pp.* 1975–1977, *June* 19, 1939.—Continuing his work on de Donder's equation [see Abstract 2736 (1939)], the author now obtains two sets of equations in Lagrangian form for the bicharacteristics. The Fermat and Maupertuis principles then follow from the extremal property. Einstein and Mayer's general field-equations are also obtained. G. C. McV.

3146. Elimination of Infinities in Electrodynamics and Masses of Elementary Particles. E. C. G. Stueckelberg. *Comptes Rendus*, 208. *pp.* 2057–2059, *June* 26, 1939.—The introduction of a minimum fundamental length into electrodynamics will eliminate infinities. The field satisfies a second-order equation, complex space-coordinates being used. In a general way it is pointed out that appropriate solutions of this equation give an order of magnitude of 1/137 for the charge of an elementary particle and of 0 or 1/137 for the rest-mass. G. C. McV.

3147. Many-Body Interactions in Atomic and Nuclear Systems. H. Primakoff and T. Holstein. *Phys. Rev.* 55. *pp.* 1218–1234, *June* 15, 1939.—When particles interact with each other through the intervening mechanism of a field, the description of their dynamical behaviour by means of action-at-a-distance potentials is only of an approximate nature. Two-body, three-body, $\cdots$, m-body potentials may be regarded as successive stages of this approximation; their relative magnitudes are examined systematically for several types of classical and quantised fields, *e.g.*, electromagnetic, mesotron, etc. It is found that the description of electrons in atomic systems by the customary two-body potentials is an excellent approximation; in nuclei, independent of the details of the field, one finds: three-body potentials $\cong (v_n/c) \times$ (two-body potentials) $\cdots$, m-body potentials $\cong (v_n/c)^{m-2} \times$ (two-body potentials), where v_n is the average velocity of the heavy particles in the nucleus. The usual description of nuclei in terms of two-body potentials cannot therefore be considered satisfactory, except in the case of the deuteron. AUTHORS.

3148. Calculation of Polarisabilities and Van der Waals Forces for Atoms in S States. J. K. Knipp. *Phys. Rev.* 55. *pp.* 1244–1254, *June* 15, 1939.—The perturbation scheme of Møller and Plesset, which has as its basis a complete set of solutions of the Fock single-electron differential-integral equation, is extended to the calculation of atomic polarisabilities and van der Waals force constants. The present treatment differs in three respects from the previous treatments of Kirkwood and Buckingham. First, the Hartree-Fock model is used consistently throughout the calculation. Additional functions are introduced to complete the set of single-electron functions. Sum rules are developed for these functions with the aid of their common Hamiltonian. These replace the Kuhn-Reiche sum rules, which do not apply in their usual form. Second, atomic polarisabilities are expressed as a sum of sums in the perturbation scheme. An ordered set of lower bounds is derived for the first of these sums and also for similar expressions for van der Waals force constants. Third, the contribution of each electron is considered separately. The lower bounds are evaluated exactly with the help of the sum rules developed. In this way are obtained for the approximate values of the atomic polarisabilities of Be and A $4\cdot14 \times 10^{-24}$ cm^3. and $1\cdot28 \times 10^{-24}$ cm^3, respectively. Likewise the constant μ in the van der Waals energy, $-\mu/R^6$, is found to be about 222×10^{-60} erg cm^6. for two Be atoms and $63\cdot7 \times 10^{-60}$ erg. cm^6. for two A atoms. The observed atomic polarisability of argon is $1\cdot63 \times 10^{-24}$ cm^3. AUTHOR.

3149. Self-Energy and Electromagnetic Field of the Electron. V. F. Weisskopf. *Phys. Rev.* 56. *pp.* 72–85, *July* 1, 1939.—The charge distribution, the electromagnetic field and the self-energy of an electron are investigated. It is found that, as a result of Dirac's positron theory, the charge and the magnetic dipole of the electron are extended over a finite region; the contributions of the spin and of the fluctuations of the radiation field to the self-energy are analysed, and the reasons that the self-energy is only logarithmically infinite in positron theory are given. It is proved that the latter result holds to every approximation in an expansion of the self-energy in powers of e^2/hc. The self-energy of charged particles obeying Bose statistics is found to be quadratically divergent. Some evidence is given that the " critical length " of positron theory is as small as $h/(mc)\cdot\exp(-hc/e^2)$. AUTHOR.

3150. Effusion and Thermal Transpiration in Quantum Statistics. B. N. Srivastava. *Roy. Soc., Proc.* 171*A*. *pp.* 469–484, *July* 7, 1939.—This paper is a continuation of the author's previous work [see Abstract 3962 (1938)] in which the molecular effusion of matter into a vacuum was considered. In the present work the molecular effusion of gas into another chamber containing gas at a different pressure or at different temperature is investigated and it is shown that the effusion from chamber 1 to 2 is equal to the effusion of gas 1 into vacuum minus the effusion of gas 2 into vacuum. The effusion of one gas into another at the same temperature but at different pressure has been calculated for the different cases. Thermal transpiration has been discussed in subsequent sections and expressions have been worked out for the different cases giving the relation between the equilibrium pressures that will obtain in the steady state between two chambers maintained at different temperatures and communicating with each other through a narrow opening. For the non-degenerate and completely non-relativistic case it is found that the equilibrium pressure ratio becomes exaggerated for matter obeying Bose-Einstein statistics and decreased for matter obeying Fermi-Dirac statistics as compared to the value for a classical perfect gas. For the completely relativistic and completely non-degenerate case the pressures are found to be inversely as the temperatures. For degenerate matter in both chambers degenerate in the sense of Fermi-Dirac statistics, the pressures are found to be equal to a first approximation, but on working to a higher approximation, the pressure in the hotter vessel is found to be slightly greater. The relation between the pressures when matter in one chamber is degenerate and in the other non-degenerate has also been calculated. AUTHOR.

See also Abstracts 3070, 3246, 3247, 3318, 3319, 3320, 3342, 3343, 3425.

PHILOSOPHY OF SCIENTIFIC METHOD.

3151. Relation between Mathematics and Physics. P. A. M. Dirac. *Roy. Soc. Edinburgh, Proc.* 59. 2. *pp.* 122–129, 1938–1939.—It is pointed out that the physicist may study nature either by the method of experiment or by that of mathematical reasoning which enables him to infer the results of yet unperformed experiments. The guiding principle in setting up mathematical theories should be mathematical beauty. It is suggested that a useful method of advance would be to study the more elegant branches of pure mathematics, *e.g.*, the theory of the functions of a complex variable, in order to discover the physical counterpart of such theories. It is pointed out that the quantum theory, with the introduction of probability, has really increased the non-mathematical part of physical theory in the same way as the necessity of initial conditions was a non-theoretical part of classical mechanics. It is suggested, however, that if the universe is of the type which began as a point-event in the past, initial conditions disappear and the quantum jumps remain as the only uncalculable part of natural phenomena. G. C. McV.

PRESSURE.

***3152. Viewing Tubes for High Pressure. J. R. Roebuck and E. E. Miller.** *Rev. Sci. Instruments,* 10. *pp.* 179–180, *June,* 1939.—An oversize tube of transparent plastic is put into a slotted steel supporting tube by cooling in liquid air. Such a device using Bakelite BT 43 001 has proven reliable at 400 atm. and calculations indicate 1000 atm. as the upper limit of safety for tubes of this general type and material. The most important feature is the absolute reliability. This is due to the fact that in operation no primary tensile stresses exist in the transparent material. AUTHORS.

See also Abstract 3363, and

1365B. Piezoelectric Gauge Measurement of Powder Pressures. R. H. Kent and A. H. Hodge.

1366B. Theory of Diaphragm-Governed Pressure Gauge. A. Möller.

RELATIVITY AND ETHER.

3153. Derivation and Significance of the "Chronotopic Interval." H. E. Ives. *J.O.S.A.* 29. *pp.* 294–301, *July,* 1939.—Starting with the Fitzgerald-Larmor-Lorentz contractions of length and frequency the measurements which can be made on a uniformly moving particle from a uniformly moving platform, using clocks and rods moved at observed finite speeds, are determined. A single quantity in the Fitzgerald-Larmor-Lorentz invariant framework is found to be determinable from such measurements. This, the so-called " chronotopic interval " is a length, which is indentified with a stationary undistorted dimension of an interferometer, which, experiencing the length and frequency contractions on motion, always gives a " null " result. The complete expression for this quantity in terms of the variant rods and clocks is given by a formula which is not identical with the invariant framework expression, but is a function of all the observed quantities, including the observed velocities of the rods and clocks. Applying the same analysis to observations made in a gravitational field, on certain assumptions, an expression is found for the " chronotopic interval " or interferometer dimension, which is a function of the gravitational constant when expressed in the invariant framework, but is identical with the non-gravitational formula when expressed in terms of variant rod and clock measurements. [See Abstracts 3541 and 3964 (1938).] AUTHOR.

SOLUTION.

See Abstracts 3332, 3405.

SURFACE PROPERTIES.

3154. Adsorption of Organic Compounds by Charcoal in Aqueous Solution. R. Amiot. *Comptes Rendus,* 208. *pp.* 1575–1577, *May* 15, 1939.—A generalisation of Langmuir's adsorption formula is tested in the cases of a number of organic compounds and found to be adequate. The constants in the formula are discussed in each case, in particular as regards their dependence on the length of the molecule. R. P.

3155. Adsorption of Pigments. Specific Surface of Zinc Oxides. W. W. Ewing. *Am. Chem. Soc., J.* 61. *pp.* 1317–1321, *June,* 1939.—The adsorption of certain one, two, and three chain aliphatic compounds on various ZnO pigments has been investigated. The glycol dipalmitate molecule covers twice as large an area as the methyl stearate molecule does. The specific surfaces of the pigments calculated from these adsorption measurements agree closely with the surfaces calculated by the photomicrographic method. The films are monomolecular or some multiple thereof in thickness. AUTHOR.

3156. Electrolyte Adsorption and Activity Coefficient. Part II. Wo. Ostwald. *Kolloid Zeits.* 87. *pp.* 284–296, *July,* 1939.—This paper continues previous work [see Abstract 2746 (1939)] and deals with the adsorption of acids by charcoal from mixtures of water and organic liquids. Previous measurements by Schilow, Lepin, Dubinin, Angelescu, and Comanescu are discussed and a qualitative explanation is given of the rule that the adsorption decreases with dielectric constant of the solvent, *viz.* that the interionic attraction is increased and such a strengthening of the ionic lattice is opposed to the decomposition of the electrolyte solution by adsorption. General validity is found, from activity coefficient calculations, of a linear adsorption relationship from aqueous solvents, and also for adsorption from organic solvents and aqueous mixtures. 13 tables of data are included from which the various activity coefficients are derived and their relationships discussed. The special case of a weak electrolyte such as acetic acid is considered at length and the abnormalities of behaviour explained. H. H. Ho.

3157. Surface Tension and Thixotropic Properties of Putnam Clay Suspensions. J. W. Belton. *Leeds Philosoph. and Lit. Soc., Proc.* 3. *pp.* 565–568, *May,* 1939.—In experiments designed to measure the surface tensions of electrodialysed Putnam clay suspensions by the bubble pressure method, it was found that the recorded pressure increased with time. Further experiments showed that only the fraction with size of particles between 100 and 200 mμ exhibits this behaviour, which is explained in terms of the thixotropic properties of the suspension. AUTHOR.

3158. Surface Tension of Equimolecular Solutions. C. Sălceanu and H. McCormick. *Comptes Rendus,* 208. *pp.* 1989–1991, *June* 19, 1939.—The difference $\Delta\gamma$ between the surface tensions of solutions of 21 various non-electrolytes and that of the pure solvent is in all cases approximately 0.8 dyne/cm./gm. mol. of solute, and is independent of the nature of both solvent and solute. In the case of solutions of an electrolyte M′X′ (*e.g.* KCl) $\Delta\gamma$ is approximately double its value for a non-electrolyte and for $M''X'_2$ (*e.g.* $CaCl_2$) three times. C. A. S.

3159. Electron Diffraction Study of Copper Oxides. H. Dunholter and H. Kersten. *J. of Applied Physics,* 10. *pp.* 523–524, *July,* 1939.—This paper describes an electron diffraction study of Cu oxides formed from evaporated Cu by exposing it in an O_2 atmosphere at various temperatures for various lengths of time. It also discusses several of the orientations which were observed in the evaporated Cu. AUTHORS.

3160. Electron Diffraction Studies of Thin Films : Structure of Very Thin Films. L. H. Germer. *Phys. Rev.* 56. *pp.* 58–71, *July* 1, 1939.—Thin films of calculated thickness of the order 30A. to one atomic layer, deposited on organic supporting foils by vaporisation in high vacuo were investigated by electron diffraction by the transmission method in the case of Au, CsI, Sb_2O_3, Pd, Cu, CuCl, Ni, CaF_2, Al, Mg, NaF, and Be, and satisfactory diffraction patterns characteristic of three-dimensional crystals were obtained. The ionic compounds produced films, even the thinnest, made up of rather large crystals, 100Å. or more on a side; in the case of metals, the films are, in general, made up of smaller crystals. Observations prove that atoms and molecules are able to move over the surface of the supporting foil, and that they are drawn together into crystals of considerable size. Crystals in metal films are randomly oriented, except for slight orientation in Al films ; crystals of some ionic compounds possess a strong preference for some particular orientation, and others are randomly oriented. No correlation is observed between average shape of crystals and degree of orientation. Intensity anomalies are observed in diffraction patterns from CaF_2 and CuCl. N. M. B.

3161. Structure of Worked Metal Surfaces. E. Plessing. *Zeits f. Physik,* 113. 1–2. *pp.* 36–55, 1939.—Electron diffraction experiments were carried out to discover whether the quasi-liquid layer formed on metal surfaces during polishing is influenced by the presence of O_2 during working. It was first established that initial working (turning, etc.) under benzene produced no oxidation or other change. Samples of Au, Ag, Ni, Fe, Cu and Zn were subsequently polished in pure O_2, *in vacuo* and under benzene (to exclude atmospheric O_2). They all gave diffraction patterns of two diffuse rings ; for any one substance the diameters were the same for all three treatments. The fact that the presence of O_2 has no effect was also shown independently as follows: (a) If a polished Ni mirror is heated *in vacuo* and the layer formed by recrystallisation broken, the interference pattern reverts to that of pure Ni. (b) The diffraction pattern of polished Zn is not composed of the pattern of ZnO nor that of the metal, but can be accounted for in terms of the liquid structure of the surface layer. Rates of oxidation of various metals (Ni, Zn, Cd, Cu) are given, and these also support the hypotheses. It is finally concluded that *no* atmospheric gas influences the structure of the surface layer. E. E. W.

3162. Parachor, Desorption Isotherm and Molecular Radius. F. Rădulescŭ. *Kolloid Zeits.* 87. *pp.* 280–283, *June,* 1939.—Relationships are derived between the parachor and the desorption isotherm, and the following general expression is found between the parachor (P) and the molecular radius (r) in capillary-adsorbed liquids, *viz.* $r = 2[P]^4[D\text{-}d]^4/RTM^3 D \ln P/P_r$, where the letters have the usual meanings. The above expression is applied to the calculation of the molecular radius, and the importance is discussed of the parachor as providing a control for the reliability of the experimental determinations of surface tension. Tables of data are included. H. H. Ho.

3163. Liquid Films. W. H. Bragg. *Roy. Inst., Proc.* 30. 4. *pp.* 687–698, 1939.—A lecture in which the past and present developments in the theory of liquid films are described, and illustrated by the soap film experiments due to Dewar and others. P. H. B.

3164. Properties of Paucimolecular Liquid Layers. D. Rădulescŭ and F. Rădulescŭ. *Kolloid Zeits.* 87. *pp.* 241–251, *June,* 1939.—The packing of the molecules of a liquid in a very narrow capillary pores and fissures (forming so-called paucimolecular layers) is considered in the light of experimental work on the desorption isotherms for pure liquids and adsorbents like active carbon [see Abstract 3196 (1937)]. It is concluded that in such layers the liquid molecules are much closer together than in normal liquids, the packing being such as to bring into contact the surfaces bounding the volumes swept out by the molecules in rotating about certain axes. The deductions from this hypothesis are in satisfactory agreement with the observed discontinuous character of the desorption isotherms. Experimental results are given upon the internal energy in paucimolecular layers. L. A. W.

3165. Electrical Properties of Multimolecular Films. H. H. Race and S. I. Reynolds. *Am. Chem. Soc., J.* 61. *pp.* 1425–1432, *June,* 1939.—Electrical measurements on multilayer molecular films are made possible by the use of a clean Hg drop electrode. Special precautions for eliminating dust from the films during building and testing were found necessary. The dielectric constant of multilayers, built up from monomolecular films of stearic and arachidic acids spread on substrates containing Ba, Cd, Ca, Cu, and Pb is 2·55 with standard deviations $(\sigma) = 3\%$. Variations apparently depend more upon the pH of the substrate, and therefore the proportion of acid to soap in the film, than upon the metal. The dielectric constant is independent of thickness and of frequency up to $10^6 \sim$. The dielectric losses are of the order of $\tan \delta = 0.0009$ with standard deviations $\sigma = 17\%$. Within the reproducibility of the measurements there is not apparent dependence of dielectric loss upon frequency of film constitution. Dielectric strengths as high as 2×10^6 V/cm. can be obtained. The extreme variations in dielectric strength probably are caused by holes, cracks, or dust particles in the films. In general, films with the highest dielectric strength were made from baths of higher pH. Skeletonised films have electrical properties in agreement with the concept of their physical structure. AUTHORS.

3166. Electrical Properties of Multilayers. R. W. Goranson and W. A. Zisman. *J. Chem. Phys.* 7. *pp.* 492–505, *July*, 1939.—This paper presents certain results on the electrical properties of multilayers of stearic acid and various stearates plated on insulating materials. The experimental data lead to the conclusion that the electrical charges of these multilayers arise from the adsorption of ions from the substrate on the carboxyl groups of the floating stearate monolayer. With a Ca-bearing substrate, for example, the first stage in the process is a conversion of stearic acid to calcium stearate and this reaction is a function of the substrate pH and consequently of the degree of ionisation of stearic acid. The next stage is represented by an adsorption of Ca ions on the carboxy groups of the calcium stearate which are carried along with the monolayer in the plating process. The electric charges of *X*-multilayers thus arise from volume distributions of positive adsorbed ions. The positive ions adsorbed on the floating monolayer induce a cloud of negative ions in their neighbourhood which, under certain conditions such as dependence on size and valency of the negative ions, may lead to electrically neutral and wetted films. With certain types of mixed films, *i.e.*, where the percentage of stearic acid present is appreciable, the rate at which the plating process is carried out becomes an important factor in determining whether *X*- or *Y*-type films can be built up, and for these cases fast dipping and withdrawal speeds can neutralise an existing multilayer charge. In plating *X*-multilayers it has been observed that after about 500 layers have been deposited, and the electrostatic repulsive field of the multilayer has thus reached a certain value, the upper portion of the submerged probe has a silvery appearance which gradually moves down the probe with increasing number of dips, and film does not adhere to the multilayer over this portion. This electrostatic repulsive field thus sets a limit to the thickness of *X*-multilayers on insulators. Under certain conditions the outer layer of multilayers dipped in film-free solutions overturns and adsorbs ions from the solution, resulting, in some cases, in wetted films and, in others, in an electrical charging of the multilayers. AUTHORS.

3167. Anomalies in Extension of Protein Films. D. Dervichian. *Comptes Rendus*, 209. *pp.* 16–19, *July* 3, 1939.—When a film of serum-albumin, B-film [see Abstract 2374 (1939)], is kept under a pressure of 4 dynes, and the pressure is then reduced to 0·3 dyne, when the pressure is restored to the original 4 dynes the area is greater than at first. This can be repeated, and in each case there is an increase in area. The increase is not directly related to the original pressure, and when the latter is small (less than 1·5 dyne) the increase in area is very small, and indeed becomes a decrease in the case of gliadin. The isotherms (pressure-area curves at constant temperature) of gliadin, serum-albumin, and ovalbumin have been studied, and various anomalies are pointed out. It is considered that even in the relatively condensed region, the film is formed of at least two phases in two dimensions. A. J. M.

3168. Latent Heat and Entropy of Spreading of Myristic and Pentadecylic Acids. W. D. Harkins and G. C. Nutting. *Am. Chem. Soc., J.* 61. *pp.* 1702–1704, *July*, 1939.—By the use of the equation $\Delta h = \lambda_{S \to F} = T\,(\partial f/\partial T)_s\,(a_F - a_S)$, the latent heats of spreading of crystals of myristic and pentadecylic acid to form a monolayer on 0·01 *N* H_2SO_4 have been determined. The measurements involved are the determination of the pressures of the film in equilibrium with the crystals at various temperatures, and that of the molecular area at each temperature and pressure. The latent heats of spreading for myristic acid are found to increase with molecular area in an almost linear way, and rise from 6020 cal./mol. at 22·1 sq. Å. per molecule to 8060 cal./mol. at 28·7 sq. Å. The corresponding increase of entropy is from $14\cdot5$ to $18\cdot9 \times 10^{-16}$ erg/°C. /mol. The latent heat of spreading is of the order of 1000 cal./mol. less for pentadecylic (15 C) than for myristic (14 C) acid. AUTHORS.

3169. Rate of Oxidation of Steels from Interference Colours of Oxide Films. D. J. McAdam, Jr. and G. W. Geil. *Bureau of Standards, J. of Research,* 23. *pp.* 63–124, *July,* 1939.—By use of interference colours, investigation has been made of the variation of thickness of the oxide film on steels with temperature and time. The rate of oxidation varies as a high power of the absolute temperature. If, over short intervals, the oxidation time at constant temperature is assumed to vary as a power of the film thickness, the exponent decreases from 100 or more for thin films to about 2 for thick films. The film thickness, for constant oxidation time, increases rapidly with the absolute temperature. If, over short intervals, the thickness is assumed to vary as a power of the absolute temperature, the exponent increases with increase in film thickness, from 1 or less to about 20 or 25. The accelerating influence of temperature thus predominates over the retarding influence of increase in film thickness. Various steels are compared, with reference to resistance to oxidation, and the influence of alloying elements is discussed. AUTHORS.

3170. Boundary Skin Formation between Hot Liquid and Cold Wall. H. v. Wartenberg. *Zeits. f. Elektrochem.* 45. *pp.* 497–502, *July,* 1939.—A liquid does not wet a solid which is colder than the temperature of solidification of the liquid. A crystalline boundary layer of fair thickness (*e.g.*, 10^{-3} cm.) is formed very quickly (*e.g.*, in 10^{-4} sec.) between the two. This speed of formation is compatible with the speed of crystallisation of metals and the higher melting salts. The layer can be removed if the convectional flow of heat warms the boundary sufficiently; this can occur in molten Cu or Ag but not steel or salts. The boundary layer severely resists the flow of heat from liquid to solid. P. H. B.

See also Abstracts 3104, 3133, 3205, 3223, 3430, and

461B. Surface Testing. J. Perthen.
468B. Oxide Films on Al. N. D. Pullen.
1307B. Electron Diffraction Study of Oxide Films on Iron. R. Jackson and A. G. Quarrell.

TIME.

See Abstract

1611B. Electric Clocks. J. Baltzer.

VISCOSITY AND FRICTION.

3171. Flow of Viscous Fluid between Two Circular Cylindrical Surfaces. T. Sakurai. *Phys. Math. Soc. Japan., Proc.* 21. *pp.* 166–177, *April,* 1939. *In English.*—A supplementary paper [see Abstract 2380 (1939)] dealing with the motion of the liquid contained in a circular cylinder in which a parallel cylinder rotates slowly and steadily about its own axis. The effect of the cylinder radius is investigated. After dealing with the problem generally by expressing the radius of the inner cylinder in terms of that of the outer, the case of almost equal radii is examined.

Data for the force acting on the outer cylinder are given in graphs, tables and monograms. P. H. B.

3172. Viscosity Function. Part II. Viscosity and Constitution. E. P. Irany. *Am. Chem. Soc., J.* 61. *pp.* 1734–1739, *July*, 1939.—Graphical analysis of viscosity data shows that most pure chemical compounds are unassociated in the liquid state. The association factors which, while derived from empirical rules of constitutionally additive viscosity, are necessary to uphold their validity, have no meaning. It can be proved that the general viscosity function contains not less than two independent constitutive parameters. It therefore appears impossible to specify single atomic constants supposed to be additive in terms of viscosity. The best approach to the problem is not through the study of the most simple chemical compounds, but that of truly polymer-homologous series of high-molecular substances. In the latter case, one parameter, expressing the polar character common to all members of the series, is constant and the second parameter becomes constitutionally additive. This has been proved by graphical evidence on various such series. The method of analysis is an extension of the principle of the functional viscosity scales reported in a preceding paper. [See Abstract 4374 (1938).] AUTHOR.

***3173. Determination of Viscosity of Liquids. C. Sălceanu.** *Comptes Rendus*, 208. *pp.* 1797–1799, *June* 5, 1939.—It is shown that the ratio of the coefficients of viscosity of two liquids moving in a capillary tube under the influence of a constant force which is exerted simultaneously on the two liquids is inversely as the square of the distances traversed by the liquids during the time for which the force is exerted. This is made use of in an apparatus, described, for the determination of viscosity. A.J.M.

3174. Viscosities of Gases at High Temperatures. G. Ribaud and V. Vasilesco. *Comptes Rendus*, 208. *pp.* 1884–1886, *June* 12, 1939.—Determinations of the coefficients of viscosity of gases, relative to that of air at O° C, have been made over the temperature range 0° to 1600° C. The gases were caused to flow through a capillary tube of Pt about 0·5 mm. in dia. and 100 mm. in length, and consistent results were obtained in two assemblies in which the tube was spiralled to diameters of 65 and 36 mm. respectively. The results are in agreement with a formula of Sutherland's type, but with the so-called Sutherland constant a function of temperature. Over the temperature range 273° to 1900° K. the value of this constant varies from 113 to 124 for air, from 110 to 120 for N_2, and from 142·3 to 168 for A, whilst for CO_2 it varies from 254 at 273° K. to 307 at 1700° K. R. W. P.

***3175. Viscometer in Works Practice. H. L. Crook.** *Soc. Glass Technol., J.* 23. *pp.* 82–107, *April*, 1939.—A rotating cylinder viscometer has been applied to works problems, and an example is given of its use in the development of a glass of increased chemical resistance. Calculated values are given for the effect of various oxides on the viscosity of glasses into which they are introduced. A discussion is given of the effect of the viscosity-temperature relationship on the "setting rate" of glasses. Some measurements on opal glasses are also reported. The viscometer has been calibrated by reference to its physical dimensions. The results given are absolute values based on this calibration. AUTHOR.

3176. Viscosity of Aqueous Solutions of Strong Electrolytes. Part V. H. Tollert. *Zeits. f. phys. Chem.* 184. *Abt.A.* 3. *pp.* 165–178, 1939.—The kinematic viscosity, density and dynamic viscosity of solutions of the nitrates of Ce, Pr, Nd, and Sm, alone, and when mixed with HNO_3, and of $Ce(SO_4)_2$ solution alone, and when mixed with H_2SO_4 have been determined for concentrations up to about N, at 20°. For the solutions of nitrates a viscosity effect was obtained, which caused the viscosity of the mixture to be less than that of the solution of the pure nitrate. The effect is due to the repression of hydrolysis of the nitrate solutions by HNO_3, the extent of which can be calculated from the magnitude of the viscosity effect, using the conception of specific ionic viscosity. The repression of the hydrolysis is a measure of the basicity of the rare earths, and shows good agreement with results obtained by consideration of reduction potentials. [For Part IV see Abstract 2760 (1939).] A. J. M.

3177. Relation Between Fluidity, Temperature and Chemical Constitution of Pure Liquids. E. C. Bingham and S. D. Stookey. *Am. Chem. Soc., J.* 61. *pp.* 1625–1630, *July*, 1939.—A simple equation relating fluidity directly to temperature has been shown to fit the data very accurately for a large number of liquids, apparently failing only for alcohols. The equation also shows a definite relation between the viscosity-temperature functions of successive members of a homologous series, making it possible to calculate the viscosity of any member of a non-associated series up to 10 C atoms at any temperature by means of only four constants. The fluidities of the aliphatic bromides from butyl bromide to decyl bromide between 0 and 100° as determined by Bayer, are given. An equation has been found to apply to some types of solutions as accurately as to pure liquids. Further investigations are being made along this line. AUTHORS.

3178. Chain Length and Viscosity of Polyoxyethylene Glycols. R. Fordyce and H. Hibbert. *Am. Chem. Soc., J.* 61. *pp.* 1912–1915, *July*, 1939.—The solution viscosities of long chain polyoxyethylene glycols have been measured in CCl_4 and dioxane at 20, 40 and 60° and agreement with the Staudinger linear relationship between chain length and $\eta_{sp.}/c$ has been obtained in each case. A slightly modified form of the Staudinger equation, *viz.*, $\eta_{sp.}/c = K'_m M + \beta$, is suggested as a more accurate mathematical expression, especially in the case of the lower members of a given homologous series. AUTHORS.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***3179. Rapid Method of Eliminating the Astigmatism Affecting Large Parabolic Mirrors. J. S. Paraskevopoulos.** *Harvard Coll. Obs., Bull. No.* 910. *pp.* 11-14, *March* 1, 1939.—Main causes for distortion of parabolic mirrors in reflectors are temperature variation and mechanical flexure, and there must be a certain ratio between aperture and thickness of such, to produce minimum distortion. He describes the 60-in. mirror (a thin one) of the Boyden Station, and its bottom support ; it is susceptible to both temperature and flexure variation, but by regulating the pressure of the 3 adjustable pads, it is possible within a short time to transform the ellipse into a perfect circle. The change of the pressure is so minute that the observer himself should operate it, and for this the observatory mechanic constructed 3 delicate transmission levers from each pad to the upper end of the tube. The result is a " rounded " image. A. S. D. M.

***3180. New Telescope Drive at Harvard Observatory. H. E. Hanson.** *Rev. Sci. Instruments,* 10. *pp.* 184–185, *June,* 1939.

***3181. Construction of Schmidt Cameras. H. W. Cox.** *Journ. Sci. Instruments,* 16. *pp.* 257–262, *Aug.,* 1939.—A description is given of the methods employed in working the correcting lenses for *F* 1·5 Schmidt astronomical cameras. Details of early work are given, leading up to the development of a technique by which a correcting lens was figured correctly in a single figuring operation. AUTHOR.

COMETS AND METEORS.

3182. Influences of Limiting Magnitude upon Meteor Frequency. F. Watson. *Nat. Acad. Sci., Proc.* 25. *pp.* 243–245, *May,* 1939.—The importance of the limiting naked-eye magnitude in the statistical discussions of meteor frequencies is demonstrated. The advantage of reducing the field of observation in calculating the frequency-characteristic is pointed out. G. C. McV.

COSMOGONY.

3183. Fission of a Rotating Fluid Mass. R. A. Lyttleton. *Roy. Astron. Soc., M.N.* 99. *pp.* 567–568, *May,* 1939.—The author criticises a paper by Edgeworth on this subject [see Abstract 1535 (1939)]. He deals with the claim that fission divides the mass into two unequal parts, and that when the change is made from circular to parabolic motion (just before instability begins) the kinetic energy of the satellite must be greater at the second position than at the first. Next he attacks the assumption that the pear-shaped process of fission is a stable one. This description of fission contends that the final result consists of the formation of a satellite :—but no satellite can have been produced in this way, since even in the earth-moon system the total angular momentum is insufficient to render the combined mass unstable. A. S. D. M.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

3184. Dynamics of Stellar Systems. Parts I–VIII. S. Chandrasekhar. *Astrophys. J.* 90. *pp.* 1–154, *July,* 1939.—The kinematical characteristics which are postulated in this paper for describing the state of motions in a stellar system are the following : (i) For every small region in the system we can define uniquely a *local standard of rest.* (ii) The different local standards of rest are in *relative motion.* (iii) The motions of the individual stars with respect to the appropriate local frames of references are distributed according to a *generalised ellipsoidal law.* (iv) The motions of the individual stars are governed by a potential function $\mathfrak{B}$. And, finally (v), the system is in a steady state. The present investigation is concerned with the dynamics of such stellar systems with *differential motions.* Mathematically, the dynamical problem reduces to finding the circumstances under which the equation of continuity regarded as a partial differential equation for the *distribution function,* ψ, admits of a solution of the form $\psi \equiv \psi(Q + \sigma[x, y, z,])$, (i), where ψ is an arbitrary function of the argument and Q is defined by $Q = a(U - U_0)^2 + b(V - V_0)^2 + c(W - W^0)_2 + 2f (V - V_0)(W - W_0) + 2g(W - W_0)(U - U_0) + 2hU) - U_0)(V - V_0)$, (ii), and σ is related to the star density at the point considered. In equation (ii), a, b, c, f, g, and h are the coefficients of the velocity ellipsoid, (U_0, V_0, W_0) and (U, V, W) define the motions of the local centroids and the individual stars with respect to a fundamental frame of reference, respectively. In the mathematical analysis it is assumed that a, b, c, f, g, h, U_0, V_0, W_0, and σ can be arbitrary continuous functions of position. The dynamical problem is formulated in Part I. It is shown here that the mathematical problem reduces to the discussion of four groups of equations : (i) a set of ten simultaneous partial differential equations which involve the coefficients of the velocity ellipsoid only ; (ii) a set of six equations which will determine the motion of the local centroid as a function of position ; (iii) a linear homogeneous partial differential equation of the Lagrangian type for the potential function $\mathfrak{B}$, and (iv) a set of three equations which lead to three other integrability conditions. In Part II the complete solution for the two-dimensional problem is given. In this part most of the known results of stellar dynamics are derived as special cases of the general theory. In Part III the first two groups of 16 equations are considered in Cartesian coordinates. It is found that the solution for a, b, c, f, g, and h involves 20 constants of integration ; the solutions for the motion similarly involve 6 further constants of integration. In Part IV a fundamental theorem in the dynamics of stellar systems is proved. It is shown here that stellar systems with differential motions must necessarily be characterised by a *helical symmetry* of the potential function $\mathfrak{B}$. In Part V the problem is discussed in spherical polar coordinates, and the complete enumeration of the different types of stellar systems which are characterised by a spherically symmetrical potential function $\mathfrak{B}$ is made. In Part VI the problem is considered in spheroidal coordinates, and certain special types of stellar systems are treated. In Part VII the problem in cylindrical coordinates is discussed. Special classes of stellar systems with axial symmetries are considered in this part. The motions inside a uniform spheroidal distribution of mass is treated ; this discussion discloses the existence of two critical spheroids in which the motions of the local centroids have components perpendicular to the galactic plane. One of these two critical spheroids is an oblate spheroid with a ratio of the axes of about 3·41 :1 ; it is suggested that the existence of this critical value for the ratio of the axes is probably connected with the known upper limit to the eccentricities of elliptical nebulæ. Finally, in Part VIII the general theory of ellipsoidal systems is described. AUTHOR.

NEBULÆ.

3185. Balmer Emission of Planetary Nebulæ. S. Miyamoto. *Kyoto Coll. Sci., Mem.* 21. *pp.* 173–202, *Nov.*, 1938. *In English.*—The effect of collisional excitation of normal H atoms is discussed in detail, particularly for " slow " collisions. The current ionisation formula is modified to take this effect into account, the velocity-distribution of the electrons being show to be Maxwellian to a high degree of approximation. The Balmer decrement turns out to be sensitive to the electron temperature and changes from 2·9 to 4·3 with electron temperature. For actual nebulæ this temperature falls between 10,000° and 25,000°. Discrete Balmer emission is a mixture of capture and collision spectra whilst the continuous Balmer emission remains a pure capture spectrum. The theory also explains why the continuous emission appears fainter than is indicated by the recombination theory. G. C. McV.

3186. Arms of a Spiral Nebula. A. C. Banerji and P. L. Bhatnagar. *Phil. Mag.* 28. *pp.* 118–126, *July*, 1939.—Previous investigations of the formation of spiral arms in a galaxy are shown to involve inconsistencies of various kinds. The authors consider the case of a rotating spheroidal central mass of finite dimensions and of uniform density, surrounded by a spheroidal structure of rotating compressible gas whose density varies plausibly. The size of the central mass is taken to be small compared with that of the outer boundary of gaseous structure. With this model the authors investigate the conditions necessary for the formation of spiral arms. The path of a particle ejected, due to a small perturbation, from the equatorial plane of the assumed galactic structure is evaluated, and spiral arms emanating from two diametrically opposite points in the equatorial plane are shown to be possible. Ionisation tends to reduce the gravitational force. From the known dimensions and period of rotation both of our own galaxy and the Andromeda nebula, upper limits of 35 and 600 parsecs respectively are obtained for the equatorial diameters of the central cores. A. Hu.

PLANETS.

3187. Period of Rotation of Mars. T. R. Widorn. *Akad. Wiss. Wien, Ber.* 147. 2a. 5–6. *pp.* 243–248, 1938.—The material on the planet's rotation-phases obtained by K. Graff during 1920, 1926 and 1937 is analysed and shown to be in accordance with the accepted period of rotation of Mars. G. C. McV.

3188. Position of the Polar Axis of Mars and the Inclination of the Martian Ecliptic. T. Widorn. *Akad. Wiss. Wien, Ber.* 147. 2*a.* 7–8. *pp.* 335–347, 1938.—The material accumulated since 1783 on the position of the axis of rotation of the planet Mars and on the obliquity of its ecliptic is discussed. An obliquity of 24° 41′ ± 57′ is deduced and the position of the axis of precession shown on a diagram. The position of the Martian North Pole from observations taken during 1909 to 1926 is A = 317°. 1, D = 53°. 6. G. C. McV.

3189. Jupiter's Atmosphere. A. C. Banerji and Nizamuddin. *Indian Journ. Phys.* 13. *pp.* 73–86, *April*, 1939.—In this paper the two models of Jupiter's atmosphere, *viz.*, adiabatic and isothermal, have been considered. The variability of the period of rotation of the atmosphere depending on the latitude and the variation of gravity have both been taken into account. The datum level of Jupiter is the effective radiating and absorbing layer—probably a cloud layer—at a certain height in the atmosphere. It has the observed temperature of 150° Abs. The authors have investigated the relation between pressure and density at any depth below the datum level and at any height above the datum level, in each of the two cases, *viz.*, (1) when the atmosphere consists of CH_4 only, and (2) when it consists of a mixture of one part of CH_4 and six part of H_2. Even taking the atmosphere to be in adiabatic condition below the datum level and in isothermal condition above the datum level the authors have found that the total thickness of the atmospheric layer cannot, in any case exceed 1900 km., and possibly it is below 1300 km. AUTHORS.

3190. Map of Mercury in 1936–1938. H. M. Johnson. *Roy. Astron. Soc., Canada, J.* 33. *pp.* 210–212, *May-June*, 1939.—A map illustrates markings at 5 east and 4 west elongations in 1936–38, from 50 drawings by 4 observers, and is based on an 88-day rotation period, involving a constant face to the sun, and assuming the subsolar point as the central one. Since the planet is near conjunction when this region is presented towards the earth, its detail is less certain than that near the terminators. Schiaparelli and Antoniadi's nomenclature is applied. When Mars and Mercury are in the same field Mars is much the redder, but the markings on Mercury seem more conspicuous than on Mars; if both were seen together under the same, but very poor conditions, there would be a great similarity between them. Mercury's north " cusp cap " often suggests an impossible polar cap. The curving of a band near heliocentric long. 130° suggests that the axis of rotation is inclined to the orbit. A. S. D. M.

See also Abstract 3183.

STARS.

3191. Visual Colour Excesses of Bright Stars in the Region of Camelopardis. K. Graff. *Akad. Wiss. Wien, Ber.* 147. 2*a*. 5–6. *pp.* 285–288, 1938.—It was noticed previously in an investigation of the visual colour excesses of stars in Cassopeia [see Abstract 2764 (1938)] that the region of coloration appeared to extend towards Camelopardis. Recent measurements in Camelopardis confirm this, and the results of the colorimetric measurements of 134 stars in this region are tabulated. J. E. K.

3192. Colours of Bright Stars in The Region of ξ, ζ, and *o* Persei. K. Graff. *Akad. Wiss. Wien, Ber.* 147. 2*a*. 5–6. *pp.* 289–291, 1938.—The galactic zone of observing clouds exhibits an indentation in the neighbourhood of Perseus within which lie the stars λ, ζ and *o* Persei and it is to be expected these stars will show considerable colour excesses. The results of colorimetric measurements of 71 stars in this region up to $7^m 5$ obtained from Mallorca in Winter 1934/35 are tabulated. The results are not entirely in accord with expectations inasmuch as only 4B stars are found to have large colour excesses. J. E. K.

3193. Relative Energy Distribution in the Infra-Red Spectra of 18 Principal Stars. H. v. Hoff. *Zeits. f. Astrophysik*, 18. 3. *pp.* 157–198, 1939.—The relative energy distribution in the region 6000 to 8500 Å has been determined for 18 stars. The photographic plates used were " Agfa 700 rapid " and " 800 rapid." An investigation has been made of the atmospheric absorption in the given spectral region and of the wire grating which served to fix the photometric scale. The magnitudes observed for different wave-lengths are tabulated. L. K.

3194. Galactic Structure in Taurus. Part II. Space Distribution of Stars. S. W. McCuskey. *Astrophys. J.* 89. *pp.* 568–586, *June*, 1939.—The region in Taurus, $\lambda = 128°$ to $150°$, $\beta = 0$ to $-30°$. The author finds a local clustering of stars near the sun, (for other longitudes there is a high negative density); at high latitudes ($-20°$ to $-30°$) there appears high concentration of stars in our immediate vicinity, which may, however, be spurious. F stars are largely in excess. At 400 parsecs from the sun, decrease in density at right angles to the galactic plane is more rapid than near the sun. At more than 1000 parsecs, maximum space density occurs at 50 to 200 parsecs from the adopted galactic plane (pole 12 hr. 40 min, and $+ 28°$). The mean values of distance and absorbing power of the nebulous material are $1{\cdot}9^m$. and 142 parsecs. There are four figures given. [For Part I see Abstract 4398 (1938).] A. S. D. M.

3195. SN NGC 1003 and Other Supernovae. D. Hoffleit. *Harvard Coll. Obs., Bull. No.* 910. *pp.* 1–11, *March* 1, 1939.—The author deals with the light curve of NGC 1003 and gives a table of the Harvard observation ; its brightness has varied less than $0{\cdot}5^m$ from March to Oct., 1938, and this observed constant brightness cannot, with certainty, be due to a possible optical companion. She compares it with other supernovae, giving a table of new observations of 12 old supernovae ; she describes them, giving the light curves of 8 of them. After the first rapid decline they show marked difference in slope. SS Urs Maj. is peculiar, having an apparent long duration maximum (of − 10·5) which is nearly 4^m less than the mean absolute maximum of supernovae. Zwicky calculates that they radiate energy of 10^{48} ergs per year. A. S. D. M.

3196. Absorption of Light from Stars in the Galactic Plane. V. Maitre. *Comptes Rendus*, 208. *pp.* 1878–1880, *June* 12, 1939.—The observed colour excess of B-type stars is generally admitted to be due to selective absorption in interstellar space. The coefficient of selective absorption is calculated by a slight modification of a method already explained [see Abstract 517 (1936)]. Stebbins' and Huffer's catalogue of colour excess is used. Uniform distribution in space is assumed, and the absolute magnitude distribution according to Strömberg. Using 386 stars of types B0-B5 within galactic latitudes ± 15°, the coefficient of absorption is found to be 0.30 magnitude for a distance of 100 parsecs. This result is compared with that of 0.21 magnitude found by Oort following a different method by based on the same catalogue. The two results are further compared after reduction to a different standard system, that of Becker. E. M. W.

SUN.

3197. Motion Pictures of Small Chromospheric Flocculi. R. R. McMath. *Roy. Astron. Soc., M.N.* 99. *pp.* 559–560, *May*, 1939.—On Aug. 13, 1938, while taking motion pictures of a dark hydrogen flocculus at the McMath-Hulbert Observatory, H. E. Sawyer displaced the second slit 0·5Å toward the violet to register a portion in the flocculus which showed velocity in the line of sight when examined in the spectrohelioscope. He got an adequate " run " on the screen, and upon projection the motions of the small dark flocculi are very clearly seen, and it was realised that it was the fine chromospheric detail that was secured; on the screen the "crawling of the small dark flocculi is well seen." The size of the markings is from 4″ to 16″.5. No value of the life-period of these flocculi has yet been found, but it is probably of the order of a few minutes of time. A. S. D. M.

3198. Travel of Protuberances. P. Puh. *Comptes Rendus*, 208. *pp.* 1793–1795, *June* 5, 1939.—Details are given of the speeds, acceleration, path, and changes of form of luminous masses constituting solar protuberances which were photographed at Pic du Midi and Meudon. The results contradict the laws given by Pettit regarding the rate of travel and its changes. Reasons are given for errors which arose in using the time-distance graph method and led to these laws. R. S. R.

3199. Annular Solar Eclipse of April 17, 1912. K. Graff. *Akad. Wiss. Wien, Ber.* 147.2*a*. 5–6. *pp.* 271–283, 1938.—Results of observations and measurements made at Hamburg in perfect weather conditions during the annular eclipse of April 17, 1912 are re-stated, as being of some current interest, under the following main headings: (1) General observations during the eclipse; (2) Kinematograph and other photographs; (3) attempted photometric measurements; (4) determination of position of moon, correction of coordinates. J. E. K.

3200. Equation of Sunspot Curve. W. Gleissberg. *Zeits f. Astrophysik,* 18.3. *pp.* 199–206, 1939.—The author shows that the relative numbers of sunspots can be represented by an equation containing 3 parameters provided that the mean values of sunspot numbers over three years are taken. These mean-values are used for the evaluation of the three parameters: time and height of the maximum of the averaged relative numbers and the time at which half the maximal value is attained. Tables are given of these parameters and of the calculated yearly averages. These calculated mean values show an error of ± 3·8. L. K.

See also Abstracts 3145, 3204.

GEOPHYSICS.

GEOPHYSICS, APPLIED.

3201. Evaluation of Geoelectric Resistivity. F. Gassmann. *Beitr. z. angew. Geophys.* 7.4. *pp.* 347–349, 1939. *English Abstract.*—In order to evaluate geoelectric resistivity measurements Watson supposes parallel layers of equal thickness. His formulæ for evaluation of apparent resistivity are corrected and supplemented. By means of introducing formulæ of recursion they are simplified in order to abbreviate numerical calculation. AUTHOR.

3202. Radio Waves Underground (Spark Geology). V. Fritsch. *Beitr. z. angew. Geophys.* 7.4. *pp.* 449–461, 1939. *English Abstract.*—Experiments were carried out in order to investigate the extension of medium and short waves in mines and layers of greater depth. The conditions of extension are investigated and an account is given of their scientific and practical importance. [See Abstract 4412 (1937).] AUTHOR.

***3203. Registration Procedure for Indicating Magnetic Elements. A. Graf.** *Beitr. z. angew. Geophys.* 7.4. *pp.* 357–365, 1939.—A photoelectric recording system is described which has been developed for Schmidt's Askania field balance. The design can be used also for any recording system equipped with mirrors such as magnetic thread instruments, spring balances and mirror galvanometers. The advantages of the method for direct reading, long distance recording, instantaneous value determination, variable paper speed, multiple recording, high sensitivity, easily variable amplification, and handiness are discussed. New possibilities of the field balance are shown. Under difficult transportation conditions the photographic method may be better but the new electrical recording method will preferably be used where a geophysical crew is investigating a larger area and is using the same base station for two weeks or months. R. S. R.

See also Abstract 3220.

LAND, PHYSICS OF THE.

3204. From the Centre of the Earth to the Sun. N.H. Heck. *Washington Acad. Sci., J.* 29. *pp.* 189–219, *May* 15, 1939.—A general scheme for the earth and an atmosphere is outlined. Seismology shows the earth to consist primarily of a core, mantle and crust. The mantle probably consists of several layers with surfaces of discontinuity not yet fully defined but those most likely are at depths of 400 and 1000 km. The crust has a varying thickness having several layers under the continents, thinner layers under the Atlantic and Indian Oceans and non-existent under the Pacific Ocean. The depths are discussed from isostatic considerations. At least 94% of the earth's total surface-field magnetism is of internal origin. The main field has a secular variation. Periodic and aperiodic variations are superimposed on it by electric currents flowing above the ground. The space distribution of these induced currents can be inferred from non-magnetic considerations with a fair degree of accuracy. From these variations information is deduced regarding the earth's interior, the atmosphere and the sun which is not forthcoming in any other way. Far u.v. light causes the ionisation responsible for diurnal variation but magnetic storms are probably associated with slower travelling solar emanations. These are associated with sunspots, but indirectly, and appear to arise from disturbed areas on the sun which may or may not have sunspots. R. S. R.

3205. Capillarity and Subsoil Water Table. M. Afzal and V. I. Vaidhianathan. *Indian Acad. Sci., Proc.* 9*A. pp.* 309–311, *April,* 1939.—In the shallower wells of some Indian provinces a slight shower of rain produces a rise out of all proportion to the rainfall. This has been reproduced in miniature by means of a tank, 4 ft. deep, filled with water-packed sand, the water having been drained off till it stands about half-way up a glass side-tube. During the course of a day the water level sank 10 cm., but resumed its original level when the surface of the sand was merely moistened. The effect is ascribed to the changes of pressure differences which occur when the added water flattens concave menisci below the dry sand surface. P. H. B.

3206. Flow of Subterranean Water. A. Sivade. *Comptes Rendus,* 208. *pp.* 1791–1793, *June* 5, 1939.—Limasset's equations for subterranean water flow are in practice modified by various simplified hypotheses and a field is obtained dependent on a velocity potential and governed by the hypotheses used. A mathematical examination of the movement of the liquid shows that where Darcy's law holds turbulence is practically zero and consequently the speeds are derived from a potential in the whole field except perhaps in the extremely thin limiting layer where the water enters the field, the surface of the water being considered as the free surface in the case where the field is fed by a fall of rain. R. S. R.

See also Abstract 3202.

METEOROLOGY.

3207. Dissymmetry of Distribution of Ozone in the Two Hemispheres. A. Vassy and E. Vassy. *Comptes Rendus,* 208. *pp.* 1829–1831, *June* 5, 1939.—Observations made in Feb. and March, 1939, in the southern hemisphere in latitude 20° to 50° S appear to indicate that the stratosphere presents polar characteristics in these regions more clearly marked in the south than in the north. [See Abstract 2444 (1939).] This led the authors to investigate whether an analogous dissymmetry exists with regard to the distribution of O_3 over the globe. For this purpose they examined the mean annual thicknesses of O_3 at stations in corresponding latitudes north and south. They find that a dissymmetry does exist but they also consider that at present there are not sufficient data to determine whether the sum total of O_3 is greater in the southern hemisphere than in the northern. The results, however, support the hypothesis that the dissymmetry existing in the stratosphere is a consequence of the unequal division of land and sea in the two hemispheres. A. E. M. G.

***3208. New Form of Pyrheliometer. A. Amerio.** *N. Cimento,* 16. *pp.* 53–58, *Feb.*, 1939.—This instrument receives the solar radiation on a small Mn plate to which are soldered at points very close together two fine wires constituting a thermopile. The recording is photographic and combines sensitiveness with simplicity. Recourse to a standard pyrheliometer is not necessary because the factors needed for reduction to absolute values of the solar radiation are supplied by the observations themselves. The advantages of the instrument are simplicity and small cost. E. M. W.

3209. Nocturnal Radiation from the Sky. L. A. Ramdas, B. N. Sreenivasiah and P. K. Raman. *Indian Acad. Sci., Proc.* 9*A. pp.* 386–389, *May,* 1939.—The observations in an earlier paper [see Abstract 1581 (1937)] are used to calculate the mean equivalent black-body temperature of the night sky as a whole, at different hours of the night. These values are compared with those computed from the simultaneous readings of an Ångstrom's pyrgeometer exposed to the whole night sky (solid angle 2π). An agreement within 2° Abs. is found. Thus radiation measurements with a thermopile and galvanometer are in fairly good agreement with those obtained by the null method used in Ångstrom's pyrgeometer. R.S.R.

3210. Atmospheric Turbulence and Nocturnal Radiation. J. Debrach. *Comptes Rendus,* 208. *pp.* 1739–1741, *May* 30, 1939.—Effective nocturnal radiation being due to the difference of two radiations one from the earth's surface the other from the atmosphere, its variation cannot in the author's opinion, depend entirely on meteorological conditions near the ground but must be influenced by conditions in the upper layers. The same elements cause variations in solar radiation also. This has led to a comparison being made between values of effective radiation and atmospheric turbulence. Numerical results are given in tabular form and also by diagram. They show a diminution of effective radiation with increase of turbulence, and a new proof of the influence of the upper layers of the troposphere on the exchange of energy by radiation between the earth's surface and the atmosphere. A. E. M. G.

3211. Propagation of a Pulse in the Atmosphere. C. L. Pekeris. *Roy. Soc., Proc.* 171*A. pp.* 434–449, *July* 7, 1939.—It is shown that in a composite atmosphere, such as was assumed in a previous paper [see Abstract 1123 (1937)] in connection with the theory of atmospheric tides, a surface pulse would excite waves of the first and second modes of oscillation, the amplitude of the former being greater than that of the latter by a factor varying from 2·4 to 2·9. This factor would tend to increase on account of dispersion. Some records of the atmospheric wave which was caused by the Krakatoa eruption of 1883 are discussed with a view to identifying the wave of the second mode. There are indications of this wave in the first passage and, to a lesser degree, in the second passage. The energy of these waves is estimated to be of the order of 10^{24} ergs. In the appendix is given the distribution with height of the vertical velocities in the two modes of oscillation of a model atmosphere. At heights of the order of 100 km., these velocities are found to be in phase with the surface pressure for *both* modes. AUTHOR.

3212. Distribution of Wet-Bulb Potential Temperature in Four Selected Cyclones. A. M. Firesah. *Roy. Meteorolog. Soc., J.* 65. *pp.* 397–410; *Disc.,* 410, *July,* 1939.—The distribution of wet-bulb potential temperature has been investigated in four cyclones, each by means of serial sounding balloon ascents made at one station. The results are plotted as though they represented observations along a vertical cross-section through the moving cyclone. Lines of equal wet-bulb potential temperature are drawn, and these are found to show a characteristic form of distribution at warm fronts, cold fronts and occlusions. At warm fronts the lines are closely crowded together. At cold fronts they show a nose raised some kilometres above the ground, the wet-bulb potential temperature decreasing with height in the air below the nose. The air in this region usually shows marked latent instability capable of being realised after only relatively small upward displacement. At occlusions the lines of equal wet-bulb potential temperature have a pronounced V-shaped form. AUTHOR.

3213. Evaporation Over Catchment Areas. Part II. D. Lloyd. *Roy. Meteorolog. Soc., J.* 65. *pp.* 385–389 ; *Disc.*, 389–396, *July*, 1939.—Information has been extracted from Government sources relating to drainage areas situate in northern Italy. Values of general rainfall, loss and weather details are tabulated. The provisional formula, advanced recently to estimate the probable loss by evaporation over catchment areas, is applied to these data. The values of loss, expected on account of the weather and permeability of sub-surface, are shown to be of the right magnitude. [For Part I see Abstract 3617 (1938).] AUTHOR.

3214. Mock Sun Observed 30th Jan., 1939. G. Alliverti. *Accad. Sci. Torino, Atti,* 74. *Disp.* 3a. *pp.* 273–275, *Jan.–March*, 1939.—On the above date, between Trofarello and Asti in Piedmont, between 15 h and 15 h 30 m, when the sun's altitude was diminishing from 20° to 17°, and the sky was full of cirro-cumulus and cirro-stratus clouds of various densities, part of a solar halo was seen of 22° radius, coloured red, yellow, and green, and on its outer (green) edge was a very bright mock sun or parhelion. Its position and distance from the sun agreed with the accepted theory of causation by refraction from ice crystals in the atmosphere. It is rarely seen in these latitudes, though visible in Holland on an average 170 times in a year. The coloured halo alone, without mock suns or moons, has, however, been seen here on some other occasions. On Aug. 16, 1936, two photographs were taken, the first of which showed the solar halo varying in different parts from 21° 48′ to 22° 29′, proving that the refraction sometimes takes place at 61° 52′. Form of halo and intensity of colour fluctuated during the ½ hour it was visible: the sun's altitude of 45° explains the absence of parhelia in this case. M. A. E.

3215. Brightness of the Night Sky. J. Cabannes. *Comptes Rendus,* 208. *pp.* 1770–1772, *June* 5, 1939.—Chapman's theory of the night-sky illumination being due to dissociation of the molecule O_2 in the day and its recombination at night is favoured. The changes in atomic levels suggested by Chapman and Martyn to explain the presence of the green ray and red doublet are examined and changes in these views are suggested. A new explanation is given for the upper levels of the principal bands observed. The exceptional intensity of the band 6500–6550 Å is considered to be due to collision of the molecule N_2 and the atom O. Only part of the atoms emit the ray 5577 Å and the ratio of the intensities of the band and ray is a function of the density of the air. R. S. R.

3216. Auroral Spectrum. R. Bernard. *Comptes Rendus,* 208. *pp.* 1831–1833, *June* 5, 1939.—Assuming that the aurora is due to electrons of solar origin the velocity of these particles ought to diminish towards the luminous region at the base, and in the author's opinion this ought to give rise to considerable modifications in the luminescence of different regions of the aurora. Particularly the variations observed in the laboratory on the positive and negative bands of N_2 [see Abstract 2499 (1937)] should be found. With the object of testing this, a number of spectrograms of the upper and lower limits of well defined auroral forms have been examined. The conclusions arrived at are summarised. In particular, the behaviour of the Vegard-Kaplan bands and the line at 3466.5Å due to atomic N is dealt with, and a table shows the variation in intensity of these radiations with height. The nature of the spectrum of any diffuse aurora is considered to be dependent upon altitude. A. E. M. G.

3217. Earth's Electric Field and Aurora. M. C. Holmes. *Frank Inst., J.* 228. *pp.* 63–68, *July*, 1939.—This paper is the third of a series [see Abstracts 2585 (1937) and 2190 (1938)]. Close observation of the earth's electric field shows variation of field strength with latitude. A diagram illustrates the probable distribution of lines of force consistent with these observations. If now the electric field have a strength of about 1/100 of its value at the surface, and it shows that it has this value at a height of about 100 km., ionisation by collision occurs wherever electric and magnetic fields are parallel. This enables the author to offer an explanation of the different forms of aurorae, their movements, their correlation with solar activity and their diurnal and secular periodicities.
A. E. M. G.

3218. Atmospheric Opacity. H. L. Wright. *Roy. Meteorolog. Soc., J.* 65. *pp.* 411–439 ; *Disc.*, 439–442, *July*, 1939..—A station may be classified as to visibility by using visibility frequencies to evaluate the atmospheric opacity, which is directly proportional to the extinction coefficient. Mean values of the atmospheric opacity in clear conditions and in foggy conditions at various stations in the British Isles are utilised to infer the contribution of the various types of nuclei and particles to the opacity, and in particular to infer the relative efficiency of each type as a fog-producer. It is concluded that sea-salt nuclei are much larger than combustion nuclei and play a leading part in the determination of visibility. The effect of combustion nuclei is negligible unless they are extremely numerous, but the concomitant smoke particles contribute largely to impairment of visibility and when plentiful may even produce thick fog. Water fogs are due to sea-salt nuclei and if supersaturation is attained the fogs may thicken considerably owing to the deposition of water on the sea-salt nuclei which consequently become very much larger. Such deposition does not occur on the combustion nuclei if sea-salt nuclei are present. The variation in opacity with relative humidity is calculated theoretically and the calculations are applied to observations of nuclei, particles, and relative humidity at Kew Observatory in the afternoon. Fair agreement is found between the calculated values of opacity and those which correspond to the visibility observed. In one appendix to the paper factors are evaluated by which the visibility of reflecting objects viewed against sky or terrestrial backgrounds may be compared with the visibility of a black object silhouetted against the sky. In a second appendix the increase in opacity during precipitation is calculated. AUTHOR.

See also Abstracts 3208, 3270.

V.
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SEISMOLOGY.

*3219. **Fast Moving Pilot-Balloon Theodolite. L. W. Pollak.** *Roy. Meteorolog. Soc., J.* 65. *pp.* 443–446 ; *Disc.,* 447, *July,* 1939.—A new pilot-balloon theodolite is described the essential feature of which is that the reading arrangements (verniers) remain stationary relatively to the vertical and horizontal scales from one reading until the next, so that the observer is able to follow the balloon continuously. AUTHOR.

3220. **Seismic-Electric Effect. K. H. Waters and Weng Wen-Po.** *Beitr. z. angew. Geophys.* 7. 4. *pp.* 337–346, 1939. *In English.*—Experiments have been carried out to determine whether the seismic electric effect is due to a true change in the ground resistivity or to other causes. The experiments tend to support the hypothesis of a resistivity change. On this basis is discussed a simplified theory giving the nature of the record when a simple resistivity discontinuity advances on the electrode system. [See Abstract 3180 (1938).] AUTHORS.

3221. **Model Studies of Vibrations of Structures during Earthquakes. M. P. White and R. Byrne.** *Seismological Soc. of America, Bull.* 29. *pp.* 327–332, *April,* 1939.—The theory is outlined of a model to study linear oscillators having one degree of freedom, with or without viscous damping, using only ground accelerations. For the same amplitude the model could, on this scheme, have smaller dimensions and smaller movements of the shaking table. W. A. R.

3222. **Travel Times Near Earthquakes. P. Caloi.** *Ricerca Scientifica,* 10. *pp.* 388–397, *May,* 1939.—The times of travel of earthquake waves near the origin are tabulated for earthquakes of N. W. Italy. W. A. R.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

3223. **Electrification of Drops. G. Lovera.** *N. Cimento,* 15. *pp.* 609–614, *Dec.,* 1938.—A *résumé* is given of observations since 1895 [see Abstract 1494 (1899)] on the electrification produced in the air surrounding waterfalls and on that noticed when the surface of various liquids is broken. Lenard's theory of the double layer is referred to [see Abstract 1446 (1915)] but the author of the summary regards the subject as a thorny and difficult one which requires further cautious experiment and observation. J. J. S.

3224. **Relation of Geological Conditions of Radio Transmission to Lightning Researches. V. Fritsch.** *Gerlands Beitr. z. Geophys.* 54. 3. *pp.* 245–328, 1939.—It is shewn that certain radio effects depend upon geological conditions, and that this throws light on areas likely to be struck by lightning flashes. Informations useful in this direction can be better obtained by the use of h.f. currents in geophysical research than by the customary l.f. methods. W. A. R.

3225. **Diurnal Variations of Vertical Electric Current, Mobility of Ions and Space Charge. O. Thellier.** *Comptes Rendus,* 208. *pp.* 2013–2015, *June* 19, 1939.—The results of observations covering a period of 6 months June to Nov., 1938, and Feb., 1939, with which the present note is concerned, have already been investigated [see Abstract 2470 (1939)]. The vertical electric current being a function of conductivity and electric field, a table is drawn up showing how these quantities vary during the day for certain specified days within the period of observation. The current shows a single diurnal variation with a minimum in the early morning. A similar treatment of mobilities indicates a very slight diurnal variation while the ratio of positive to negative mobilities is given as 0.80. The variation of space charge indicates a maximum in the evening. A. E. M. G.

3226. Harmonic Analysis of Diurnal Variations for Single Days. J. Bartels. *Terr. Mag.* 44. *pp.* 137–156, *June,* 1939.—The forthcoming volume of results at the Watheroo and Huancayo magnetic observatories will contain an extensive table of about 40000 harmonic coefficients for the diurnal variations in the horizontal magnetic intensity H at Huancayo Magnetic Observatory (Peru) for every individual day of the years 1922 to 1936. This collection of coefficients, a new feature in observatory compilations, represents an advanced stage of reduction of the original magnetic records beyond the usual hourly means, and will be used as material for discussions on the variability of the solar and lunar diurnal variations. H at Huancayo has been selected for the first table of this kind because of the unusual features of its large diurnal variation. A new scheme for numerical harmonic analysis of diurnal variations for this mass-reduction had to be developed yielding, in the most economical way, the coefficients of the periods 24, 12, 8, and 6 hours. This scheme and allied topics are described in detail in this paper, because they may be useful in similar geophysical work. AUTHOR.

See also Abstracts 3201, 3203, 3204, 3217, 3220.

RADIOACTIVITY.

3227. Natural Radioactivity of Lu. W. F. Libby. *Phys. Rev.* 56. *pp.* 21–23, *July* 1, 1939—The half-life of the natural radioactivity of Lu reported by Heyden and Wefelmeier is $2 \cdot 9 \pm 0 \cdot 5 \times 10^{12}$ years for the element or $7 \cdot 3 \pm 2 \times 10^{10}$ years for Lu^{176}, which probably is the active isotope. Negative electrons are emitted. The upper energy limit of the spectrum is 215,000 ± 15006 eV. AUTHOR.

***3228. Detection of Radioactive Contamination, Using Geiger-Müller Counters. L. F. Curtiss.** *Bureau of Standards, J. of Research,* 23. *pp.* 137–143, *July,* 1939.—Situations frequently arise in which it is desirable to determine the extent of accidental contamination by radioactive materials. Such contamination occurs in research laboratories where radioactive studies are in progress and also in commercial plants where radioactive materials are handled. An important example of the latter is the dial-painting plants, where self-luminous radium paint is applied. This article describes a portable Geiger-Müller counter operated entirely from a.c. mains, which permits a rapid and accurate determination of such contamination wherever it exceeds the equivalent of about $0 \cdot 5\,\mu$ gm. Ra/m². The device is also sufficiently sensitive to determine the presence of Ra in amounts of micrograms in a living person and therefore may be used for routine test of workers, their garments, and objects habitually handled by them. The instrument is very rugged, readily portable, and silent in operation. Requiring no batteries of any kind, it is always ready for use. Commercial radio parts are used well within their ratings throughout, with the exception of the tube counter itself, so that there is little danger of failures, and the parts are easily replaced if they should fail. The indicator is a milliammeter, which is arranged to have a very steady deflection under constant conditions and is yet sufficiently sensitive to measure 1 μgm. of Ra at a distance of 1 m. The device may therefore be used for intercomparison by γ-radiation of samples of Ra of low activity. It has been tested under practical conditions and has been found well suited for surveys of contaminated locations. It also is a very sensitive detector for finding lost Ra preparations and for testing Ra ores of commercial value. AUTHOR.

3229. Prospects of Technical Utilisation of Energy-Content of Atomic Nuclei. S. Flügge. *Naturwiss.* 27. *pp.* 402–410, *June* 9, 1939.—A report on recent papers dealing with this problem in connection with the newly discovered fission of the U nucleus. L. E. F.

3230. Transmutation Function for Deuterons. P. L. Kapur. *Indian Journ. Phys.* 13. *pp.* 87–90, *April,* 1939.—It is shown that there is a limit to the validity of the picture of " partial entry " of deuterons in the coulomb potential barrier of bombarded nuclei in nuclear reactions in which the neutron of the deuteron is captured and that this limit comes out very beautifully from the theory [see Abstract 144 (1938)]. A graph showing the relation of the total energy of the out-going proton to the energy of the incident deuteron for different values of the potential barrier is also plotted. AUTHOR.

3231. Possibility of Disintegration of Very Heavy Nuclei into Two Nuclei of Medium Weight. U. Fano. *J. de Physique et le Radium,* 10. *pp.* 229–233, *May,* 1939.—General theoretical considerations are used to show that heavy nuclei may be unstable against deformations from the spherical shape. As far as the numerical constants are known, the heaviest known nuclei just appear to be near the limit of stability. Different possible ways are discussed in which the collision with a neutron could produce this kind of instability in a nucleus which is just stable. R. P.

3232. Calculation of Possible Conditions for Chain Reactions in U. F. Perrin. *Comptes Rendus,* 208. *pp.* 1573–1575, *May* 15, 1939.—The previous calculation [see Abstract 2823 (1939)] is extended to include the action of thermal neutrons, making extreme simplifying assumptions about the mechanism of the slowing-down. In this case the system will be stable, since the liberation of energy will raise the temperature and therefore reduce the efficiency of thermal neutrons. The temperature at which stability is reached depends on the size of the U sphere that is used and on the H and Cd content. R. P.

3233. Energy and Range of Heavy Disintegration Products of U. O. Haxel. *Zeits. f. Physik,* 112. 11–12. *pp.* 681–688, 1939.—Using proportional counters lined with uranium oxide, measurement is made of the energy and range of the heavy particles produced by the disintegration of U by neutrons. Two groups of fission products have energy losses of 41 and 35 eMV per cm. of air. From Bethe's theoretical work the corresponding *effective* nuclear charges are 10 and 7 respectively. A table summarises the properties of the fission products. F. C. C.

3234. Products of Disintegration of U by Neutrons. P. Abelson. *Phys. Rev.* 56. *pp.* 1–9, *July* 1, 1939.—Products of U fission which are chemically Sb, Te and I have been examined. The following activities have been found :

Sb	Te	I	Atomic Weight
80 hr.	10 hr.		127
4·2 hr.	70 min.		129
	30 min. 30 hr.	8 days	131
5 min.	77 hr.	2·4 hr.	132, 134 or 136
<10 min.	43 min.	54 min.	
<10 min.	60 min.	22 hr.	

Three activities—the 10-hour Te, the 70-min. Te and the 8-day I—have been identified with known bodies through comparison of half-lives and β-ray spectra. Genetical relationships of the activities have been established by a technique of periodic separations and by the observation of growth in activity curves. AUTHOR.

3235. Artificial Radioactivity of Pb Produced by Neutrons. H. de Vries and G. Diemer. *Physica,* 6. *pp.* 599–600, *July,* 1939. *In English.*—It is shown that the only radioactive element formed by both fast and slow neutron irradiation of lead is of 80 min. period ($n - 2n$ reaction). AUTHORS.

3236. Precise Determination of Energy Released in Production of D from Be under Proton Bombardment. L. S. Skaggs. *Phys. Rev.* 56. *pp.* 24–29, *July* 1, 1939.—The kinetic energy of the deuterons liberated in the reaction Be^9 (p, d) Be^8 has been measured by deflecting the deuterons in an accurately known electrostatic field. The technique of the use of the electrostatic deflector is discussed, and experimental arrangements appropriate to the determination are described. From measurements at proton energies of 258, 262, and 315 kV the energy released in the reaction is found to be $0\cdot557 \pm 0\cdot006$ eMV. The shift of the high energy limit of the deuterons with bombarding voltage establishes the masses of the particles involved. By combining the result with other energy data as known at present it is shown that (*a*) the threshold for the disintegration of Be^9 by γ-rays is $1\cdot62 \pm 0\cdot02$ eMV. (*b*) Be^8 is stable with respect to disintegration into two α-particles by $0\cdot174 \pm 0\cdot09$ eMV. Revision of the present values of the mass-spectrographic bracket between D_2 molecules and He, or the value of the energy released in the reaction Li^6 (d, α) He^4 would necessitate revision of conclusion (*b*). The experimental evidence on the stability of Be^8 is briefly discussed. AUTHOR.

3237. Excitation of γ-Rays in Process of Proton Capture. S. C. Curran and J. E. Strothers. *Roy. Soc., Proc.* 172*A*. *pp.* 72–88, *July* 19, 1939.—The excitation functions for the γ-radiations emitted by the elements D, Li, Na, Mg, P and Cl under proton bombardment have been determined for energies of the incident protons from 0 to 10^6 eV. Resonance peaks, hitherto unobserved, have been found in the excitation curves for incident protons of the following energies :—^{23}Na : 425, 525, 590, 690, 755, 875 $\times 10^3$ eV ; ^{25}Mg : 180, 410, 480, 575, 825 $\times 10^3$ eV ; ^{26}Mg : 580, 680, 1000 $\times 10^3$ eV ; ^{31}P : 460, 580, 700, 950 $\times 10^3$ eV ; ^{37}Cl : 650, 800, 1000 $\times 10^3$ eV. In the case of ^{7}Li no evidence of any resonance peak other than that at 440 kV could be obtained. No capture γ-radiation could be detected during the bombardment of ^{6}Li and D with protons of energies up to 10^6 eV. The yield of γ-radiation was measured in the case of ^{25}Mg and ^{26}Mg, the values obtained being $3\cdot0 \times 10^{-10}$ quanta per proton at 825 kV (^{25}Mg) and $2\cdot1 \times 10^{-10}$ for ^{26}Mg at

680 kV. The energy of the capture γ-radiation was measured in each case from observations of the end-points of the absorption curves which were obtained by placing Al sheets between the pair of Geiger-Müller counters used for the detection of the γ-rays. AUTHORS.

3238. Colouring of Biotite by α-Rays. G. Kürti. *Akad. Wiss. Wien, Ber.* 147. 2*a*. 9–10. *pp.* 401–413, 1938.—A microphotometric arrangement is described in which the photographic plate is used as a null instrument. Measurements have been made to investigate the formation of colouring haloes in biotite. It is shown that the colouring effects of α-particles along their paths are subject to the same kind of regularities as the ionising effects in air. A curve showing colouring effect against time of irradiation indicates that the effects cannot be interpreted in terms of saturation. J. E.

3239. Stopping Power of Mica for Slow α-Particles. W. Riezler. *Ann. d. Physik*, 35. 4. *pp.* 350–353, *June*, 1939.—Measurements were made with an ionisation chamber and Lindemann electrometer to determine the absorption in a thin mica sheet of a collimated beam of slow α-particles from Po (4–25 mm. residual range). Relations between ionisation current and residual range, residual range and thickness of mica, and energy loss and residual range, are shown graphically. [See following Abstract.] E. E. W.

3240. Ionisation and Range of α-Particles in SF_6. W. Riezler. *Ann. d. Physik*, 35. 4. *pp.* 354–358, *June*, 1939.—Relationships between ionisation and range and energy and range, were determined for α-particles up to 4 MV energy, using an ionisation chamber. SF_6 was used on account of its high stopping power and chemical stability. The relative stopping power of SF_6 for α-particles from Po is $3{\cdot}91 \pm 0{\cdot}06$ and the ionisation for 3 MV α-particles is $1{\cdot}08$ (both values cf.air $= 1{\cdot}00$). Graphs are given showing the energy-range relation, and energy loss due to ionisation. Energy loss is not found to be accurately proportional to ionisation. [See preceding Abstract.] E. E. W.

3241. Resonance Phenomena in α-Ray Scattering by Light Nuclei. S. Devons. *Roy. Soc., Proc.* 172A. *pp.* 127–142, *July* 19, 1939.—The scattering of α-particles at 90° has been investigated for the elements C, N, O, F, Ne and A. The scattering substance was in the form of a gas and the scattered particles were detected by means of an annular chamber and linear amplifier. Resonances in the scattering have been found for α-particle energies as follows: C, 5·7; N, 4·6 and 5·2; O, 5·8; F, 3·5, 4·7; Ne, (—) eMV. The results are discussed with relation to the interpretation of scattering on the " many-body " theory of the nucleus and also in connection with other experimental data on scattering and disintegration. The results are not of a very high accuracy, owing to low intensity and resolution of the α-particle sources used. AUTHOR.

3242. β- and γ-Rays of Ac B and Ac C″. B. W. Sargent. *Canad. J. of Research*, 17. *Sect. A. pp* 82–102, *May*, 1939.—The absorption method of determining the end point of a β-ray spectrum was perfected. The end point, E eMV, as determined by the magnetic spectrograph is related to the range, R (cm. Al)deduced from an absorption curve showing log (ionisation)/(gm./cm^2 of Al traversed) by the equation $R = 0.526E - 0{\cdot}094$ ($E < 0{\cdot}6$ eMV). The final portions of the absorption curve of β-rays from RaE and UX_2 have the same shape. Growth curves for the β-activity of the active deposit from filtered actinon were obtained. The range of the β-rays of AcB and AcC″, for which separate absorption curves obtained are 0·64 and 0·68 $gm./cm^2$. Al respectively corresponding with end points 1·39 and 1·47 eMV. There is some evidence that the β-spectrum of AcB consists of two components with end points at 1·39 and 0·5 eMV, the difference between which (0·89) is approximately equal to the energy (0·83) of a γ-ray emitted in the transformation AcB,C; the numbers of β-particles in the soft and hard components are as 1 : 7. C. A. S.

***3243. Small Cloud Chamber for Electron Showers. J. E. Thomas, Jr. and W. E. Ramsey.** *Frank Inst., J.* 227. *pp.* 789–799, *June*, 1939.—The paper describes an automatic cloud chamber, designed to satisfy the conditions of portability, and high efficiency and selectivity in recording electron showers. The last two conditions are satisfied respectively by the use of a continuously sensitive surface of long narrow counters below the chamber and three counters inside the chamber underneath the specimen. Photographs are taken simultaneously, by means of inclined mirrors, from directly above and directly below the chamber. Tracks are very easy to count, but accurate length measurements are precluded by the small depth of the chamber. A large measure of freedom from turbulence is obtained by a honeycomb grid in place of the usual wire gauze. A diagram of the counter circuit is given, and the method described by which the discharge of the requisite number of counters operates the lighting, camera shutter, etc. A specimen photograph is included. E. E. W.

***3244. Efficiency of Electron Counters. J. de Vries and G. J. Sizoo.** *Physica*, 6. *pp.* 593–598, *July*, 1939. *In English.*—A simple method is described for the determination of the efficiency of counters used for the measurement of magnetic β-spectra. Two counters are arranged in such a way that every electron which enters the second counter has to pass the first one. With two counting sets the number of coincidences given by the two counters, as well as the number of counts given by the second counter is measured simultaneously. The quotient of these numbers represents the efficiency of the first counter. With this method the efficiency of an air-filled counter was measured for electrons with energies between 1000 and 8400 $H\rho$. The results can be represented by the formula $1 - e^{-\sigma n}$ in which n denotes the mean number of ions made by an electron which passes the counter, and σ is the chance that a primary ion is followed by a discharge. If the values of n are calculated with the aid of the results of Williams and Terroux [see Abstract 2223 (1930)] obtained from cloud chamber photographs, the value of σ is found to be practically constant and equal to 0·44 within the limits between which the experimental conditions are varied. ($H\rho = 1000$ to 8400 gauss-cm; pressure of the air in the counter 6·2 to 10 cm. Hg). AUTHORS.

***3245. Characteristics of Tube Counters and Resolving Powers of Amplifiers. K. E. Forsman.** *Zeits. f. techn. Physik*, 20. 6. *pp.* 169–180, 1939.—Examination was made of the effect of different resistances between the supply battery and the screen grid valve on the behaviour of the counter. With suitable values of amplifier resistance, resolution of coincidences to $1\cdot6 \times 10^{-6}$ sec. was obtained. Change in the counter potential between certain limits produced no change in the coincidence count. The collision process in the counter was also examined and it was found that in addition to the normal discharge, others of small intensity also occurred. F. C. C.

See also **Abstracts 3104, 3107, 3109, 3426, 3436.**

RADIATION.

ABSORPTION.

See Abstract 3278.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

3246. Quantum Mechanical Theory of the Cotton-Mouton Effect. T. Neugebauer. *Zeits. f. Physik*, 112. 5–6. *pp*. 257–277, 1939.—Formulæ are derived by quantum mechanics for the Cotton-Mouton effect for diatomic molecules having large, medium and very small multiplet splitting with and without orbital momenta, for polyatomic molecules with and without spin momenta and for paramagnetic ions, and are compared with experimental results. The only case in which the formulæ for a molecule having a magnetic moment agree with those derived by classical theory is that of a diatomic molecule having a large multiplet splitting. J. E. K.

3247. Comparison with Experiment of Quantum-Mechanical Formulæ for Magnetic Double Refraction. T. Neugebauer. *Zeits. f. Physik*, 113. 1–2. *pp*. 115–125, 1939.—The Cotton-Mouton constants, which up to the present are purely experimental values for the cases of diatomic gases, have now been computed from the theoretical formulæ and the two sets of values are compared and discussed. In the case of N_2, the h.f. paramagnetic polarisability may now be derived, and this enables the experimentally known susceptibilities in the diamagnetic and in the h.f. paramagnetic field to be resolved. For O_2, which represents an extreme *b*-case, the theoretical formulæ have to be somewhat remodelled, since it is no longer possible to transform this molecule to permanent molecular axes. Further, the negative sign of its Cotton-Mouton constant affords a proof independent of band spectroscopy that the magnetic spin moment is predominantly in the direction of the rotation axis. The calculated Cotton-Mouton constants for NO is in good agreement with the experimental values, especially when the anisotropic term is considered. An immeasurably small Cotton-Mouton constant is derived from the theoretically known h.f. paramagnetic polarisability of the H_2 molecule. H. H. Ho.

***3248. Variation of Magnetic Rotatory Power and Susceptibility of Paramagnetic Solutions with Temperature. M. H. Ollivier.** *Ann. de Physique*, 11. *pp*. 461–503, *May–June*, 1939.—Various properties of solutions of salts are first studied including variation of density with temperature, and absorption, determined by a photoelectric method. Two pieces of apparatus for the determination of magnetic rotation are described. Applying an additive rule the specific magnetic rotatory power of a number of substances has been determined. Solutions with positive diamagnetism (ZnI_2, $NaNO_3$, and similar salts) were studied for comparison with paramagnetic salts with the same anion. The following classes of paramagnetic substances were differentiated: cerous and ferrous salts, where the temperature variation of specific magnetic rotatory power shows a complete parallelism with that of susceptibility; salts of Mn and Gd, which are highly paramagnetic, but where the kation is supposed to be in the S state, and the magnetic rotatory power of the kation is zero; salts of Ni which are highly paramagnetic, but of which the kation behaves, as far as magnetic rotation is concerned, like an ion with positive diamagnetism.

A. J. M.

See also Abstracts 3103, 3450.

EMISSION.

3249. Brightness of Black-Body Radiators at Temperature of Freezing Platinum. H. Willenberg. *Phys. Zeits.* 40. *pp.* 389–394, *June* 1, 1939.—It has been agreed to use as the primary standard of light, the brightness of a black-body radiator at the solidifying point of Pt. The form of black-body used in the present work is similar to that employed in America and elsewhere [see Abstract 3791 (1931)]. The new candle is 1/60 of the candle-power of 1 sq. cm. of the black-body and measurements have been made at the Physikalisch-Technische Reichsanstalt to determine the candle-powers of certain specially constructed lamps in terms of this new unit. The precautions taken to avoid or correct for the various sources of error are described in detail. The lamps used were operated at a colour match with the black-body which was found to have a colour temperature of 2047° K. Other lamps, operated at a colour-temperature of 2360° K, were measured in terms of the new candle by using a blue glass filter to bridge the colour difference. J. W. T. W.

***3250. Registration of Partial Counter-Coincidences. S. Gorodetzky.** *Comptes Rendus,* 208. *pp.* 1987–1989, *June* 19, 1939.—This paper describes a simple modification of the usual coincidence-counting circuit, to record coincidences only when certain specified counters in the group discharge simultaneously, and not when all the counters discharge coincidently. Examples of the application of such an arrangement, and an illustration of the great saving of time rendered possible in certain circumstances, are given. D. H. F.

3251. Recent Advances in Cosmic Rays. T. H. Johnson. *Washington Acad. Sci., J.* 29. *pp.* 233–256, *June* 15, 1939.—A general account is given of the experimental evidence on which deductions of the energy and nature of cosmic rays are based. It is shown how these lead to the conclusion that there is a hard and a soft component at sea-level: the identification of the soft component with electrons, and the necessity for postulating a new, unstable particle (the mesotron) to account for the hard component, is discussed. These particles, being unstable, cannot be primary, and the evidence relating to the nature of the primary radiation which gives rise to them is outlined. D. H. F.

3252. Cosmic Rays on the Pacific Ocean. P. S. Gill. *Phys. Rev.* 55. *pp.* 1151–1159, *June* 15, 1939.—Records of cosmic-ray intensity obtained on the R.M.S. *Aorangi* during 15 new voyages between Vancouver Canada, and Sydney, Australia, from July 28, 1937, to Sept. 23, 1938, with a Carnegie model C cosmic-ray meter, are discussed and compared with records taken during 11 voyages on the same route previously reported by Compton and Turner [see Abstract 5319 (1937)]. The observed minimum of cosmic-ray intensity near the equator averages 10·3% less than the intensity at Vancouver, in good agreement with the value given by Compton and Turner. The correlation between the cosmic-ray intensity and the atmospheric temperature is confirmed. An atmospheric temperature coefficient is found to be a function of latitude, with its highest numerical value of − 0·25% per °C. for latitudes higher than 40° (N. and S.). With this variable temperature coefficient a latitude effect (about

8·5%) of magnetic origin alone is found. The mean latitude effect curve for 25 trips, corrected for external temperature, is flat beyond the critical latitudes (about 40° N. and 38° S.). The difference in cosmic-ray intensity between the N. and S. hemispheres beyond the critical latitudes after this temperature correction is found to be 0 ± 0·1% (probable error). This is inconsistent with a galactic rotation effect as great as the 0·5% predicted by Compton and Getting, but does not definitely rule out a more recent modification of their calculation. The origin of the latitude effect knee is ascribed to the minimum energy required for a primary electron to produce mesotrons capable of traversing the atmosphere. The small magnitude of the latitude effect is shown to supply strong evidence of the secondary nature of mesotrons. AUTHOR.

3253. Variations of Cosmic-Ray Intensity with Atmospheric Pressure and Temperature at Sea-Level. J. Clay and E. M. Bruins. *Physica,* 6. *pp.* 628–632, *July,* 1939. *In English.*—A few results are given from the records of three different ionisation-chambers, two under 110 cm. Fe, one under 12 cm. Fe. A daily influence, generally *parallel* to temperature, is found in the instrument shielded by the thin layer, but not in those shielded by the thick layer, and only during the winter. It is found that the short periodic variations are not followed by the thickly shielded instruments. The *long periodic* variation with temperature is generally *antiparallel.* Moreover, temperature and pressure variation are nearly the same in all three instruments. From the values found, a barometric coefficient of – 6·4% per cm. Hg is found and a temperature coefficient of – 0·21% per °C. The high value found for barometric variation is not explained, but seems to be probably connected with the high values sometimes found at large angles with the vertical. AUTHORS.

3254. Decay of Cosmic Rays in Different Directions. J. Clay, K. H. J. Jonker and J. T. Wiersma. *Physica,* 6. *p.* 648, *July,* 1939. *In English.*—A correction. [See Abstract 1140 (1939).]

3255. Absorption of Hard Cosmic Rays in Different Materials. J. Clay and A. G. M. van Gemert. *Physica,* 6. *pp.* 649–655, *July,* 1939. *In English.*—The decrease of the penetrating component of cosmic rays was measured in different directions in small cones of 16° and the decrease in water, slatestone, iron and lead was compared. 1 m. lead is equivalent to 6·9 m. of water. The decrease in iron and lead is according to electron density but in water it exceeds in proportion to this density. The percentage of secondaries in different directions is about the same. The hardness of the rays in the direction of 60° is such that in the first 30 cm. Pb traversed there is practically no decrease of hard rays. The influence of barometer variation is much more pronounced in directions at 60° with the vertical than in a vertical direction. AUTHORS.

3256. Ionisation by Cosmic Rays in Gases. J. Clay and H. J. Stammer. *Physica,* 6. *pp.* 663–672, *July,* 1939. *In English.*—The ionisation by cosmic rays was measured in N_2, A, Kr, Xe in the same vessel at different pressures. The measurements were performed between two cylinders with a difference of 2·1 cm. in radius in order to set up nearly uniform fields. The ionisation currents were measured generally for 5 different fields between 50 and 500 V/cm. From the values obtained the saturation value could be found. The constants for the gases could be taken from the experiments already performed with γ-rays. The Jaffé-Zanstra formula gives also in this case a linear relation between the collecting time for a certain charge and the $f(x)$. The values for A were in

agreement with those found previously in another vessel the volume of which was 8 times larger. The ionisation from the iron wall was the same. The ionisation values for the gases N_2, A and Kr were in linear relation with density above the critical pressure for the given vessel. $I_{p>p_1} = a + bp$ and under this pressure $I_{p<p_1} = cp$. The ionisation for different gases increases more rapidly than in proportion to density. For the four gases the ionisation at sea-level in a shield of 12 cm. Fe is $I = -0 \cdot 80 + 139\,d$.
AUTHORS.

3257. Cosmic Rays. J. Clay. *Ned. T. Natuurk.* 6. 11–12. *pp.* 194–220, 1939.—Absorption experiments show that cosmic rays consist of a hard and a soft component. "Showers" of cosmic rays have been investigated by means of three Geiger Counters. Soft showers have been investigated in the Wilson cloud chamber and the occurrence of electrons of very great energy —33×10^6 eV—have been observed. Investigations of cosmic rays at various heights in the atmosphere are described both for Amsterdam and Bandoeng. Curves showing the intensities at places of various magnetic dip—Saskatoon 60° N. Omaha 51° N, San Antonio 38° N, and Madras 3° N—are given. The penetrating cosmic rays are identified as mesotrons; these mesotrons may be either positive or negative.
G. G.

3258. Cosmic-Ray Showers and Penetrating Particles. J. C. Street. *Frank. Inst., J.* 227. *pp.* 765–788, *June,* 1939.—This paper is based on one read at a symposium in June 1938. It describes experiments carried out by Fussell, in which shower production in three sheets of Pb, 0·67, 0·67, and 0·07 cm. thick were observed in a cloud chamber. The photographs, and the size-distribution curves derived from them, confirm the multiplicative theory of shower-production. The showers entering the chamber from 15 cm. of Pb were also studied. The size-distribution curve suggests that two processes of shower-production occur: there are small showers, probably originating from electrons liberated by a penetrating particle, and larger showers often containing penetrating particles. Experiments performed with two chambers, beneath an arrangement of counters and Pb designed to select penetrating particles, gave the relationship between momentum and penetration of the particles, and lead to the conclusion that they are of mass about 1/10 that of the proton.
D. H. F.

3259. Theory of Shower Explosions in Cosmic Rays. W. Heisenberg. *Zeits. f. Physik,* 113. 1–2. *pp.* 61–86, 1939.—Continuing previous work [see Abstract 4678 (1936)] on the theory of the production of cosmic-ray showers, the position is reviewed in the light of Yukawa's meson theory. Various implications of the theory are followed up and the conclusion drawn that in only very few cases are meson showers produced by cascade processes. Little further definite information seems likely until more experimental data are amassed.
F. C. C.

See also Abstracts **3426, 3436,** and

158B. Radiation from Hg Discharge Lamps. H. Krefft.
597B. Luminous Efficiency of Incandescent Electric Lamps. H. Pécheux.

FLUORESCENCE AND PHOSPHORESCENCE.
LUMINESCENCE AND AFTERGLOW.

3260. Response of Fluorescent Materials to Short Wave-Length U. V. Radiations. N. C. Beese. *J.O.S.A.* 29. *pp.* 278–282, *July,* 1939.—A quartz monochromator has been used to measure the relative response of several synthetic phosphors in the region of 2200 to 3150 Å. The deactivating effect of Cu and Ni on certain substances is represented graphically. With a vacuum grating spectrograph the response characteristics of zinc silicate and calcium tungstate have been extended to the Schumann u.v. region. AUTHOR.

3261. Fluorescence of Carbonyl Compounds in the Gas Phase. M. S. Matheson and J. W. Zabor. *J. Chem. Phys.* 7. *pp.* 536–538, *July*, 1939.—The fluorescences of biacetyl, acetone, ethyl methyl ketone, and acetaldehyde have been photographed. The main portions, at least seem to be identical. A like similarity in the fluorescences of diethyl ketone and propionaldehyde suggests that diketones formed during the photolyses of these carbonyl compounds are the fluorescing substances. AUTHORS.

3262. Luminescence of Adhesive Tape. E. N. Harvey. *Science*, 89. *pp.* 460–461, *May* 19, 1939.—The luminescence observed when substances sticking closely together are suddenly pulled apart is considered to be due to electrical discharge in air or other gas, the potential being increased to discharge point by the sudden decrease of capacity between the two surfaces. In Ne the colour of the luminescence is the characteristic colour of the Ne discharge. The writer has found that a large number of crystals, shells, glasses, etc. show luminescence in Ne when broken or shaken about. J. E.

3263. Luminescence During Intermittent Optical Excitation. R. P. Johnson and W. L. Davis. *J.O.S.A.* 29. *pp.* 283–290, *July*, 1939.—The paper presents the results of a study of the build-up and decay of some 200 samples of silicate, tungstate, molybdate and sulphide phosphors, excited by Hg 2536 Å radiation. The normal silicates decay at first exponentially, with a time constant of the order of 10^{-2} sec. This initial rate is independent of the intensity and the duration of the excitation, and varies little among different samples of a given class (*e.g.*, $Zn_2SiO_4 \cdot Mn$). The later decay is slower, and does vary markedly from sample to sample, and depends on the intensity and duration of the excitation. $CaWO_4$ decays too rapidly to be measured with the apparatus used ($< 50\ \mu$ sec.); the decay of $MgWO_4$ lasts about 2×10^{-4} sec.; both these tungstates show a very faint long phophorescence which can be enhanced slightly by addition of impurities. The red luminescence contributed by Sm in these and other " pure " phosphor decays exponentially with a time constant of about 7×10^{-4} sec. Sulphides have complicated decay characteristics, dependent on the intensity and duration of the excitation. Comparison is made with the results of a study of decay after electron bombardment, and with other published data. AUTHORS.

3264. Fatigue in Luminescence under Electron Bombardment. W. Grotheer. *Zeits. f. Physik*, 112. 9–10. *pp.* 541–559, 1939.—A number of substances show a decrease in luminosity if the electron bombardment is kept up for times of the order of 10 min. The decay curve may be described as an exponential curve, superimposed on a constant amount which remains after long periods. The effect is not appreciably influenced by the loss of transparency which is due to precipitated metal in the substance. This loss of transparency is separately measured and its influence is allowed for. From the curve obtained with constant electron intensity it is possible to account quantitatively for all phenomena observed with an intermittent or oscillating electron beam. R. P.

See also Abstracts 3267, 3248, and

355B. Fundamental Principles of Fluorescence. G. R. Fonda.
601B. Fluorescent Lamps. G. E. Inman.
1698B. Effects of Impurities on Fluorescent Compounds. J. W. Marden and G. Meister.

INTERFERENCE, DIFFRACTION AND SCATTERING.

3265. Photometric Study of "Rings at Infinity" Produced by Half-Silvered Films. J. Roig. *Rev. d'Optique*, 17. *pp.* 424–441, *Dec.*, 1938.—Photometric methods previously described [see Abstract 4915 (1938)] are used for a detailed study of the interference rings at infinity produced by a half-silvered film. The method can be used for mapping the contours of spectral lines; and it is shown that the Cd 6438 line, as excited under high frequency, is strongly perturbed. C. B. A.

See also Abstracts 3138, 3169, 3362, 3382.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

3266. U.V. Emission in Thermolysis of Thallium Azide. R. Audubert and C. Racz. *Comptes Rendus*, 208. *pp.* 1810–1811, *June* 5, 1939.—Thermolysis of TlN_3 in an atmosphere of N_2 is unaccompanied by radiation whatever the pressure (p). In O_2 (or air) if p is $\ngtr 0 \cdot 1$ mm. there is also no radiation, but if p is 2—10 mm. it appears at $206° \pm 5$ and if > 10 mm. at $267° \pm 3$. The energy of activation of the thermal decomposition, if p is 2—10 mm. is 43000 ± 2500 cal. below $228° \pm 8$, but 21600 ± 2000 above, and with $p > 10$ mm. 65800 ± 2000 cal. A possible explanation is discussed, and it is suggested that Tl, like Na, can inhibit the photogenic reaction, and that in O_2 there are two oxidation processes producing radiation. [See Abstract 2040 (1938).] C. A. S.

3267. Photo-Oxidation of Hydrocarbon Solutions. E. J. Bowen and A. H. Williams. *Faraday Soc., Trans.* 35. *pp.* 765–771, *July*, 1939.—The fluorescence efficiencies and the fluorescence quenching by oxygen of solutions of aromatic hydrocarbons have been compared with the quantum efficiences of photo-oxidation. The results show that while quenching and oxidation represent similar processes in some examples, in others certain complexities appear. The best manner of visualising the results is discussed. AUTHORS.

3268. Speed and Average Grain Size of Photographic Emulsions. A. P. H. Trivelli and W. F. Smith. *Kodak Research Lab., Comm. No.* 708. *Phot. J.* 79. *pp.* 463–468, *July*, 1939.—An extended investigation has been made concerning the straight-line proportionality between average grain size and H. and D. speed in emulsion series with :—(*a*) different AgI contents; (*b*) different times of finishing; (*c*) different gelatins; (*d*) different times of development. It was shown that this relation holds for a wide range of grain sizes. Definite deviations were actually found in two cases :—(1) With a pure AgBr emulsion having extremely large grains. (2) With larger grain silver bromo-iodide emulsions with a gelatin having a lower sensitivity factor. [See also Abstract 2874 (1939).] AUTHORS.

***3269. Photographic Speed Measurement by Relative Characteristic Gradients. C. Tuttle.** *Kodak Research Lab., Comm. No.* 726. *J.O.S.A.* 29. *pp.* 267–277, *July*, 1939.—It has been proposed that the speed of a photographic emulsion be specified upon the basis of the exposure value at which the gradient of the H. and D. characteristic becomes equal to a definite fraction of the average gradient throughout the tonal range used in making the camera exposure. The adoption of such a criterion necessitates the use of easily applied methods and special instruments for the determination of gradients and gradient ratios. In this paper a number of such methods and instruments are discussed under the following headings: (1) The graphical method. (2) A device for reading speed directly from the plotted characteristic curve. (3) A direct visual photometric method (using a wedged sensitometric strip). (4) An alternative direct visual method (using a triple sensitometric wedge and a special photometric field). (5) A direct photoelectric method of measuring gradient (which reduces the error in gradient determination occurring in visual photometry). (6) A photoelectric method incorporating a constant gradient ratio device (which eliminates the need of mental calculation). (7) Making automatic the determination of speed (pointing out means for automatic recording of results). Errors introduced by non-uniformity of coating and processing and means for minimising these errors are discussed. AUTHOR.

3270. Photography of Fine Dust Particles. D. G. Beadle. *Journ. Sci. Instruments*, 16. *pp.* 262–263, *Aug.*, 1939.—It is shown that by using great contrast, both optically and photographically, more dust particles can be photographed than can be seen visually. AUTHOR.

3271. Stability and Preservation of Records on Photographic Film. B. W. Scribner. *Bureau of Standards, Misc. Publ. M*162. [17 *pp.*], 1939.—In view of the importance of photographic film as documentary material the Bureau of Standards is investigating its stability, etc. Two types of film are tested, one coated with a photographic emulsion, the other with a light sensitive dye incorporated in the base to form the image. Bases used are nitrate, acetate and viscose. Stability is tested by heating to 100° C for various periods and then examining the folding endurance, weight, acidity, etc. The acetate film is found very suitable for record making, the nitrate definitely unsuitable, whilst the viscose appears to be suitable where only moderate longevity is required. The combined effect of light and temperature to which film is exposed in projectors appears not to be a serious consideration. Various recommendation are made as to storage, handling, etc. A. H.

***3272. Recent Development in Surveying Instruments. M. N. Macleod.** *Phys. Soc., Proc.* 51. *pp.* 710–732, *July*, 1939.—Surveys recent optical developments of interest either because of novelty or because of importance to the surveyor. The main subjects discussed are theodolites and air photography. In connection with the latter cameras, lenses, plotting apparatus, automatic plotting machines and comparators are dealt with. A. H.

See also Abstracts 3181, 3349, 3367, and
515B. High-Speed Kinematography. R. W. Palmer.
1614B. H.F. Film Recording. B. Richter.

PHOTOMETRY.

3273. Photometry of Approximately Point Sources. Y. le Grand and E. Geblewicz. *Comptes Rendus*, 208. *pp.* 1845–1846, *June* 5, 1939.—The apparent intensity of sources subtending an angle between 60″ and 150″ of arc have been measured. For very small sources the intensity is governed by the flux of light entering the eye, but for diameter beyond 2′ of arc the apparent change in size of object is easily visible and modifies the apparent intensity. Experiments are described in which the intensity of a 15″ source is compared with larger sources. The larger sources require a greater flux for equality by factors varying from 1·03 to 1·4 according to the size of the source. W. D. W.

3274. Use of Filters in Heterochromatic Photometry. H. König. *Helv. Phys. Acta*, 12. 4. *pp.* 313–329, 1939. *In German.*—An investigation was made of the behaviour of different filtered and unfiltered Se cells with regard to yellow and red light. The results obtained appear to indicate that in subjective photometry the normal employment of filters involves partial spectral equalisation even with objective receivers. It is found that by the use of band-pass filters a primary comparison of monochromatic light in or near the middle of the visible spectrum with the light from an incandescent lamp is possible, using Se cells, to an accuracy of 2 %. It is also shown that the artificial precision eye, consisting of thermopile and combination filter, in the mean part of the visible spectrum, is capable of an accuracy of 1 % with reference to spectrophotometric data. The results are discussed from a practical point of view. A.W.

***3275. Photoelectric Null Indicator for Matching Light Intensities. M. Kniazuk.** *J.O.S.A.* 29. *pp.* 223–225, *June*, 1939.—An electronic null indicator for matching light intensities is described. It can be adapted to almost any instrument in which there is a sufficient intensity of light, or where the required increase in intensity can be provided. The condition of balance is observed upon a Kathode-ray tube, and the proper adjustments performed manually. Although the arrangements is sensitive, observations are not affected by a large state of unbalance, or any other type of overload. AUTHOR.

See also Abstracts 3249, 3265, and

160B. Illumination Intensities Due to Line Sources. J. Ondracek.
1699B. Sill Ratio Method of Measuring Daylight in Buildings. F. L. Knowles and J. E. Ives.

POLARISATION.

3276. Depolarisation of Light Passing through Suspensions of Amidon. N. Calinicenco. *Comptes Rendus*, 208. *pp.* 1807–1809, *June* 5, 1939.—Using the Cornu birefringent method the following data have been obtained concerning the depolarisation of light passing through suspensions of amidon : (i) the angle of depolarisation is proportional to the radii of the suspended particles (rice amidon and starch suspended in water) ; (ii) the depolarisation of light decreases with increase in temperature, becomes zero at 82° for suspensions of rice amidon and at 66° for suspensions of potato amidon, and the temperature of disappearance is related to the shape of the suspended grains ; (iii) the depolarisation is of the same order for suspensions of amidon in water, acetone, petrol, toluene and xylene ; (iv) when amidon paste is allowed to settle it separates into two definite parts, the lower part consisting of a gelatinous precipitate of amylose, and the upper part containing amylopectin. When suspended in water amylose show as weak depolarisation, but amylopectin has no effect on light. W. R. A.

3277. Asymmetric Solvent Action. T. S. Patterson, A. H. Lamberton, and (in part) R. M. Cunningham. *Chem. Soc., J. pp.* 962–967, *June*, 1939.—From the work herein described it appears that (1) *l*-nicotine and ethyl *d*-tartrate have a considerable mutual solvent influence, (2) the tartrate raises the rotation of the nicotine (in an absolute sense), (3) similarly the nicotine raises the rotation of the tartrate, (4) ethyl *i*-tartrate has a slightly greater effect than ethyl racemate, (5) the *iso*butyl tartrates show a generally similar and consistent behaviour, as compared with the ethyl derivatives. [See also Abstract 4020 (1937).] AUTHORS.

3278. Infra-Red Pleochroism and Fermi Resonance Associated with CH_2 Groups in Crystals. J. W. Ellis and J. Bath. *Phys. Rev.* 55. *pp.* 1098–1099, *June* 1, 1939.—An examination of infra-red absorption bands in crystals containing CH_2 groups and the pleochroism displayed by the dependence of these bands upon the azimuth of vibration of the electric vector E. A. H.

See also Abstracts 3124, 3331.

REFLECTION, REFRACTION AND DISPERSION.

3279. Optics of Thick Lens. F. Staeble. *Zeits. f. Instrumentenk.* 59. *pp.* 250–253, *June*, 1939.—It is shown that the product of the distances of the foci from the respective surfaces of a thick lens depends only on the focal length, thickness and refractive index of the lens, and the refractive indices of the bounding media. The relationship can be used to determine the positions of the principal points. The question of the signs of the focal lengths on object and image side respectively is discussed in detail. C. B. A.

3280. Phase Anomaly of Optical Waves (particularly Spherical). H. W. Breuninger. *Ann. d. Physik*, 35. 3. *pp.* 228–250, *June*, 1939.—The author examines the phase anomaly δ which occurs when a convergent spherical light-wave passes through a circular hole. For an axial beam, δ as a function of the distance from the screen oscillates through an interval which depends on the same distance. The difference between the mean values of δ before and behind the focus of the wave is π. The width of this interval is π near the focus and shrinks with increasing distance from the focus. If the screen is shifted to infinity, the interval does not shrink along the axis. The interval through which δ oscillates along a beam, decreases with growing distance from the focus if the angle between axis and beam is increased. If a rectangular opening is used instead of a circular, δ converges along the axis towards zero for great distances before the focus and towards π behind the focus. L. K.

3281. Calculation of Optical Constants. R. Tousey. *J.O.S.A.* 29. *pp.* 235–239, *June*, 1939.—The determination of optical constants, by measurement of specular reflection coefficients, is discussed for the extreme u.v. region of the spectrum. A graphical method is described and curves given for handling cases where the incident light is unpolarised. A. H.

***3282. Accuracy in Refractometry. H. W. Straat and J. W. Forrest.** *J.O.S.A.* 29. *pp.* 240–247, *June*, 1939.—A study of the accuracy obtainable in refractometry and the extent to which this accuracy is dependent upon the degree of manufacturing control exercised over a few fundamental factors, such as angle and index of the refracting prism, choice of a test piece, etc., A. H.

3283. Immersion Method for Refractive Indices of Minerals. T. Carpanese. *Zeits. f. Krist.* 101. 4. *pp.* 284–289, 1939. *In Italian.*—A mixture of a liquid (I) of low volatility and high refractive index, *n*, (*e.g.*, methylene iodide, α-bromonaphthalene) with a liquid (II) of high volatility and low *n* (*e.g.*, $CHCl_3$, C_6H_6, CCl_4, CS_2) is used as auxiliary liquid. The sample of mineral is placed in a cylindrical glass dish the bottom of which consists of two parallel plates of high n, and is covered with I; and II is then added drop by drop till refractive index n_s of the mixture is slightly less than that, n_p, of the mineral. The liquid is then evaporated till $n_s = n_p$, the dish then covered and n_s determined with the total refractometer. The method is very quick and easily repeated. S. J. G.

3284. Fluorescence Test for Striæ and Cords in Glass. M. A. Besborodov and N. O. Abeltchuk. *Soc. Glass. Technol., J.* 23. *pp.* 73–75, *April*, 1939.—A fluorescence test is described for the indentification of a luminous and siliceous cords in glass. In the test, alumina-rich cords give a yellow fluorescence, but silica-rich cords do not affect the grey fluorescence given by glass in u.v. light. AUTHORS.

3285. Fine Structure of Glasses. Part III. E. Kordes. *Zeits. f. phys. Chem.* 43. *Abt. B.* 3. *pp.* 173–190, 1939.—A number of binary and pseudo-binary systems containing SiO_2 have been investigated, whose mixtures in the glassy state have shown almost complete additivity of molecular volumes; that is, there is no packing effect. This is to be expected for typical molecular bindings. This holds for organic, inorganic and mixed systems. [For Part II see Abstract 2892 (1939).] F. S.

***3286. Jewel Inspection Microscope. F. E. J. Ockenden.** *Journ. Sci. Instruments*, 16. *pp.* 228–230, *July*, 1939.—A microscope incorporating an objective with a built-in illuminator and illuminating system is described. The use of this device greatly facilitates the measurement of the radii of polished spherical surfaces by optical means, particularly when of the order of 0·1 mm. or less. AUTHOR.

See also Abstracts 3138, 3175, 3179, 3336, and
611B. Light Reflection from Painted Surfaces. J. A. Meacham.
882B. Materials for Reflecting Surfaces. W. Irby.
1472B. Aluminium Reflectors. J. D. Edwards.

SPECTROSCOPY.

3287. New Terms in Fe I, II, and III and Additional Far U.V. Standards. L. C. Green. *Phys. Rev.* 55. *pp.* 1209–1217, *June* 15, 1939.—The iron spectrum excited in the Schüler discharge in He and Ne and the iron arc and spark in N_2 have been studied in the u.v. from λ2300 to λ600. New terms have been identified in Fe I, II, and III and in addition a number of unclassified levels have been found in Fe II. Lists of all lines identified from new or previously known levels are given. These lists include a number of lines in the region λ2225 to λ1550 whose wave-lengths can be accurately calculated by the combination principle from levels whose positions are determined by measures at longer wave-lengths. These lines will be useful as standards. AUTHOR.

3288. Pressure Displacements in Fe II Spectrum. C. J. Humphreys. *Bureau of Standards, J. of Research*, 23. *pp.* 125–135, *July*, 1939.—The changes in wave-length of the intense u.v. lines in the second spectrum of iron, resulting from changes of pressure upon the source amounting to 1 or 2 atm. have been measured with Fabry-Perot interferometers. The primary purpose of the experiments was to obtain data that would permit adjustment of the Fe II wave-lengths of Burns and Walters, which were obtained by measurements of lines emitted by a vacuum arc, to equivalent arc-in-air values, thus furnishing an additional set of independently determined wave-lengths for consideration as international secondary standards. These pressure effects are observed to be extremely small; of the order of 1 part in 6,000,000 for 1-atm. change, sufficient to affect the seventh figure of proposed secondary standards in the case of only one of the observed term combinations. AUTHOR.

3289. Arc Spectrum of Europium. H. N. Russell and A. S. King. *Mt. Wilson Observat., Contrib. No.* 611. *Astrophys. J.* 90. *pp.* 155–203, *July*, 1939.—Most of the strong lines of Eu 1 arise from transitions between terms of multiplicity 10, 8, and 6, obtained by adding two electrons to $(4f)^7\,{}^8S^0$ of Eu III. This part of the spectrum is regular in every respect and contains typical multiplets and numerous short series. The lowest level is $f^7s^2\,{}^8S^0$. All the terms arising from the added electrons 6s 7s, 6s 8s, 6s 5d, 6s 6d, 6s 6p, 6s 7p,and 5d 6p have been indentified, and some from 6s 7d, 6s 5f, 6s 6f, $(5d)^2$, and $(6p)^2$. There are many additional energy levels, which probably arise from the configurations $f^6\,ds^2$ and $f^6\,d^2s$. The number of classified lines is 1156, including all but one of the 200 strongest. The ionisation potential is 5·64 V. Tables are given showing the terms and unclasssfied levels, the electron configurations, the series relations, the intensities in multiplets, and a complete list of classified lines. The probable error of a tabular wave-length is ± 0·010 Å for the stronger lines and ± 0·017 for the faintest group. AUTHORS.

3290. Spectra of Pd, Ag and Au between 90 and 250 Å. H. Sauvenier. *Comptes Rendus*, 208. *pp.* 1724–1725, *May* 30, 1939.—Using a glass spectrograph with a concave grating (288 lines/mm.) and a dispersion of 4 Å/mm. the spectra of Pd, Ag, and Au have been examined from 90 to 250 Å. The spectra are characterised by (*a*) very large rays due to transitions between outer levels, and (*b*) the bands of free electrons. The wave-lengths and magnitudes of the various bands are given and briefly discussed. W. R. A.

3291. Intercombination Rays in He Spectrum. P. Jacquinot. *Comptes Rendus*, 208. *pp.* 1896–1898, *June* 12, 1939.—In the He spectrum certain rays are accompanied by very weak satellites, some of which have been previously observed, but only under certain conditions (electric field, stellar atmospheres etc.). The new rays are attributed to intercombinations between singlet and triplet systems (*o*– and *p*–He) previously considered to be forbidden. The wave-length, intensity, frequency displacement for the principal line of each group, and the transitions to which they are attributed, are given. [See Abstract 2894 (1939).] W. R. A.

3292. Intensity Variation of Electron-Excited Hg Lines with Density of Hg Vapour. O. S. Duffendack and O. G. Koppius. *Phys. Rev.* 55. *pp.* 1199–1208, *June* 15, 1939.—The variation in the intensities of Hg lines with the abundance of Hg present was investigated experimentally both for Hg alone and for Hg vapour in a mixture with another gas. The source consisted of a normal l.v. arc and this source was used because it closely approximates the simple ideal source desired; namely, one in which electrons of definite and controlled energy are projected through a space containing Hg and possibly other atoms so that an electron may not make more than one exciting or ionising collision in its passage through the gas. Tests indicated that the ideal conditions were closely approximated. Theoretical formulae were developed for the relationship between the intensities of the Hg lines and the density of the Hg vapour (abundance of Hg). The measured values were found to be in good agreement with those given by the formulae. The relation of this investigation to the practices of quantitative spectrochemical analysis is pointed out. An analytical curve for the determination of Hg in such mixtures as were employed can be obtained from the data and the equation of the curve can be derived from the formulae deduced. AUTHORS.

3293. Nuclear Magnetic Moments of N^{14}, Na^{23}, K^{39} and Cs^{133}. P. Kusch, S. Millman and I. I. Rabi. *Phys. Rev.* 55. *pp.* 1176–1181, *June* 15, 1939.—The nuclear gyromagnetic ratios of N^{14}, Na^{23}, K^{39} and Cs^{133} have been measured by the molecular beam magnetic resonance method. The values of the nuclear magnetic moments, obtained from these measurements and the known spins, are 0·402, 2·216, 0·391 and 2·572 nuclear magnetons for N^{14}, Na^{23}, K^{39} and Cs^{133}, respectively. The shape of the resonance curves in some cases indicates a type of interaction of the nucleus with the rest of the molecule which may arise from the nuclear electric quadrupole moment. It is of interest to note that for the case of the alkali nuclei the magnetic moments calculated from the observed hyperfine splitting of atomic energy states by use of the Goudsmit, Fermi-Segrè formula agree fairly well with the results here given. [See Abstract 2090(1939).] AUTHORS.

3294. Hyperfine Structure of Metastable $^2P_{3/2}$ State of $In^{115}I$ and Electric Quadrupole Moment of In^{115}. D. R. Hamilton. *Phys. Rev.* 56. *pp.* 30–38, *July* 1, 1939.—The zero-moment method of atomic beams has been used to investigate the hyperfine structure of the metastable $^2P_{3/2}$ state of $In^{115}I$. Thirteen zero-moment peaks have been observed, and it is found that their behaviour is completely described by the equation for the h.f.s. energy levels, $E = \frac{1}{2}aC + bC(C + 1)$, together with a knowledge of the nuclear g factor. a and b are the interval rule and quadrupole interaction constants, respectively; the numerical values are $b/a = (6{\cdot}432 \pm 0{\cdot}04) \times 10^{-3}$; $a = (8{\cdot}10 \pm 0{\cdot}10) \times 10^{-3}$ cm^{-1}.; $b =$ $0{\cdot}0521 \pm 0{\cdot}0009) \times 10^{-3}$ cm^{-1}. From this the total h.f.s. separation is $(0{\cdot}1184 \pm 0{\cdot}0015)$ cm^{-1}. and the quadrupole moment of In^{115} is $0{\cdot}84 \times 10^{-24}$ cm^2. The nuclear spin is verified to be 9/2. If there is an additional term $c(C^3 + 4C^2 + 4/5C)$ in the h.f.s. energy level equation, as suggested by Tolansky in the case of iodine, an upper limit of 5×10^{-6} may be set on c/a. AUTHOR.

3295. Electrical Quadrupole Moment of the Iodine Nucleus. T. Schmidt. *Zeits. f. Physik,* 113. 1–2. *p.* 140, 1939.—The author's previously published value of $-0{\cdot}5 \times 10^{-24}$ for the quadrupole moment of the iodine nucleus [see Abstract 2525 (1939)] has been contradicted by one of $+0{\cdot}85 \times 10^{-24}$ almost simultaneously published by Murakawa [see Abstract 2526 (1939)]. The author now discusses how the discrepancies between the two values have arisen and especially indicates two cases of oversight by Murakawa, *viz.*, for the charge number Z and for the absolute value of the multiplet split, which change his value to $-0{\cdot}33 \times 10^{-24}$. Discrepancies in the values taken for the coupling constant account for the balance of the difference. H. H. Ho.

3296. Self-Reversal of Spectral Lines. L. Sibaiya. *Indian Acad. Sci., Proc.* 9*A*. *pp.* 219–223, *March,* 1939.—From measurements on reversed lines obtained from cooled hollow kathode sources (Ag, Cu, Mo, Au, etc.) it is concluded that the extent of self-reversal in the various lines of a given multiplet is not the same, but that the ratio of the extent of the self-reversal of two or more lines of a multiplet remains constant independently of experimental conditions. The self-reversals in the two components of the same arc lines are unequal but the reversal ratio is constant and independent of experimental conditions. A theoretical explanation is advanced. W. R. A.

3297. Infra-Red Spectrum of Ascorbic Acid. E. Heintz. *Comptes Rendus*, 208. *pp.* 1893–1896, *June* 12, 1939.—The infra-red spectrum of solid ascorbic acid has been investigated from 1 to 14μ and bands are assigned to different groupings in the molecule. Solutions containing 0·4 and 0·1 *M* ascorbic acid, buffered to pH 2·71, exhibit the same spectrum as the solid to 8μ except that with the 0·1 *M* solution two new bands, attributed to $> CO$ and $- OH$ groups, appear. This suggests that in the weaker solution ascorbic acid has undergone a molecular transformation. W. R. A.

3298. Oscillation Frequencies of Nitrates. D. Williams and L. Decherd. *Am. Chem. Soc., J.* 61. *pp.* 1382–1384, *June*, 1939.—Early infra-red measurements on bands in the 7 to 9μ region arising from the NO_3 group showed that the frequencies were reduced when the salts were in solution. In the present work the spectra of several nitrate solutions were studied between 6 and 16μ. The results obtained are in agreement with previous results except in the case of KNO_3. The infra-red data are compared with the existing Raman data. Authors.

3299. Vibration-Rotation Bands of Polyatomic Molecules in the Photographic Infra-Red. H. W. Thompson. *J. Chem. Phys.* 7. *pp.* 441–447, *July*, 1939.—The infra-red absorption of methyl mercaptan, *a*-methyl hydroxylamine, methyl nitrite, methyl formate, dimethyl ether, formamide, methyl fluoride, methyl chloride, methyl bromide and methyl iodide has been measured over the range of 7000–12000 Å using low dispersion. The intense bands have been re-examined using higher dispersion. An analysis has been made of some bands in the spectra of the methyl halides. A parallel band of methyl fluoride suggests a moment of inertia of $33{\cdot}7 \times 10^{-40}$ gm. cm^2. The spacing between the *Q* branches in perpendicular type bands appears to be irregular, and other peculiarities are noticed which indicate that the simple theory may need modification. Author.

3300. Infra-Red Spectrum of Methylamine. H. W. Thompson. *J. Chem. Phys.* 7. *pp.* 448–452, *July*, 1939.—The infra-red spectrum of methylamine has been measured over the range 7000–12000 Å using low dispersion, and a vibrational assignment has been made to the bands observed. The rotational structure of a band at 9950 Å previously reported has been examined under higher dispersion. The band is of the perpendicular type and an analysis leads to values of the molecular structural constants in agreement with those to be expected on other grounds, namely $r_{\text{CN}} \sim 1{\cdot}47$ Å, $r_{\text{NH}} \sim 1{\cdot}02$ Å, $C - \hat{N} - H$ 108°, and a tetrahedral methyl group. There is no evidence for the occurrence of internal rotation in the methylamine molecule. Author.

3301. Infra-Red Band of Formic Acid at 7525 Å. H. W. Thompson. *J. Chem. Phys.* 7. *pp.* 453–455, *July*, 1939.—The absorption band of formic acid vapour at 7825 Å has been investigated. This is a hybrid band in which the perpendicular-type component is the more intense. The main features of the rotational structure have been measured and by making reasonable assumptions the small moment of inertia is found to be $10{\cdot}83 \times 10^{-40}$ gm. cm^2. The band is entirely similar in structure to the next lower harmonic band at 9801 Å. Author.

3302. Infra-Red Absorption Spectrum of BF_3. D. M. Gage and E. F. Barker. *J. Chem. Phys.* 7. *pp.* 455–459, *July*, 1939.—The infra-red absorption spectrum of BF_3 has been studied under high resolution from 400 cm^{-1} to 3000 cm^{-1}. The active fundamentals ν_2, ν_3 and ν_4 and the overtone $2\nu_3$ have been observed. The parallel fundamental ν_2 has been partially resolved and the value of the moment of inertia A found to be 79×10^{-40} gm. cm^2. The B — F distance is $1 \cdot 29 \times 10^{-8}$ cm. The isotope effect due to the two isotopes of B was observed in all bands. The appearance of the unresolved bands ν_4 and $2\nu_3$ is shown to be greatly influenced by the interaction between vibration and rotation.

AUTHORS.

3303. Vibration Spectra and Molecular Structure. Part VII. Further Infra-red Studies on Vapours of Carboxylic Acids. R. C. Herman and R. Hofstadter. *J. Chem. Phys.* 7. *pp.* 460–464, *July,* 1939.—The monomer and dimer spectra of the vapours of CD_3COOD, CD_3COOH, C_2H_5COOH and C_2H_5COOD have been obtained in the near infra-red with a rock-salt spectrometer. The association of C_2H_5COOD has been studied and the value of the heat of association obtained is 7000 cal./mol. per bond. [See Abstracts 4128–4130 (1938).]

AUTHORS.

3304. Completion of Term Schemes of Carbon Monoxide. Part III. L. Gerö and R. Schmid. *Zeits. f. Physik,* 112. 11–12. *pp.* 676–680, 1939.—Vibration and rotation steps of $d^3\Pi$ and $a^3\Pi$ states are studied. [For Part II see Abstract 4067 (1937).] W. R. A.

3305. Infra-Red Bands and Association of Hydroxylic Compounds. H. W. Thompson. *Am. Chem. Soc., J.* 61. *pp.* 1396–1400, *June,* 1939.—The absorption bands in the region 8000–11000 Å of a series of simple hydroxylic compounds have been measured. The nature of the bands in some cases and the effect of temperature upon them reveals the existence of molecular association in the liquid state. In some cases, such as that of ethanolamine, unusual effects are noticed which cannot be satisfactorily explained. AUTHOR.

3306. Near Infra-Red Absorption of Naphthalene Derivatives. P. Barchewitz. *Comptes Rendus,* 208. *pp.* 1991–1993, *June* 19, 1939.—The infra-red absorption of naphthalene and several derivatives has been investigated from 0·6 to 1·0 μ. The spectrum of naphthalene in CCl_4 solution resembles closely that of benzene. with the (CH) band of both in approximately the same position. This indicates that the two benzene rings forming the molecule do not produce internal tensions. The fundamental band is, however, not simple but formed of at least two components (3068 and 3053 $cm.^{-1}$). In the spectrum of α-methylnaphthalene, the (CH) band is found displaced relative to its position in the spectrum of naphthalene, the Me group acting as electropositive with respect to the $C_{10}H_7$ radical. The displacement of the (CH) band increases with the number of substituents, and for isomers (1·6–, 2·6–, and 2·3– dimethylnaphthalene) this displacement is greatest when the molecule has the highest symmetry. Complex (CH_3) bands are also observed in the spectra of the methylnaphthalenes. In the naphthols the displacements of the (CH) band are small; intense (OH) bands are found at 9738 (α–) and 9722 Å (β–) (*cf.* 9720 Å for the (OH) band in phenol and 9630 Å in aliphatic alcohols). In agreement with the fact that the C–Cl and $C–NO_2$ linkings have negative electric moments, the (CH) band of naphthalene is displaced to shorter wave-lengths in the α–chloro- and nitro-naphthalenes, and the value of the displacement depends on the magnitude of these moments. W. R. A.

3307. Infra-Red Absorption Spectra of Xylidines and the Phenomenon of Steric Hindrance. Yeou Ta. *Comptes Rendus*, 208. *pp.* 1993–1995, *June* 19, 1939.—1. 3. 2-xylidine (I) is distinguished from its isomers by its chemical reactions (*e.g.*, inability to form a quaternary ammonium salt with CH_3I). The peculiar behaviour of (I) has also been demonstrated in two ways by examination of its infra-red absorption spectrum. The absorption spectra have been observed from 7000 to 5500 cm.$^{-1}$ of the isomers 1. 3. 2-, 1. 3. 5-, and 1. 3. 4-xylidines in the pure liquid state. This range includes the first harmonics of the aromatic (CH) bands, and of the (CH_3) and (NH_2) bands. The 4 isomers are distinguished by (*i*) the different nature of the complex (CH) band, (*ii*) the difference of the (CH_3) band in (I), and (*iii*) the marked intensity of the (NH_2) band in (I). The modifications produced in the spectra by dilution with CCl_4 have also been observed. The most intense (NH_2) band (the V_1 band) is displaced on dilution towards higher frequencies, and is the most displaced for (I); on the other hand the increase in intensity of the bands V_1 and V_2 on dilution is less for (I) than for its isomers. These facts are explained by the assumption of partial association by means of the linkage $NH \rightarrow N$, with the V_1 and V_2 bands corresponding with the free oscillations of the NH_2 radical in non-associated molecules. The intensity and frequency of these bands thus indicate the number and the state of these molecules respectively. The band S_1, the intensity of which decreases on dilution, is then characteristic of associated molecules. The peculiar behaviour of (I) is explained as due to steric hindrance to association, the NH_2 group being situated between two closely placed Me groups. W. R. A.

3308. Spectra of Molybdenum Chlorides. P. Mesnage. *Comtes Rendus*, 208. *pp.* 1721–1723, *May* 30, 1939.—The emission spectrum of $MoCl_3$ consists of two parts, one of which arises from arc rays of the metal and the other and less brilliant is due to the spectrum of the molecule. The absorption spectrum of $MoCl_5$ contains many visible and u.v. bands and the influence of temperature and pressure on their intensities and manitudes is discussed. $MoCl_5$ vapour, below approximately 200°, gives spectrum *A* consisting of a band in the visible, two u.v. bands and a region of far u.v. absorption. Above 300°, a similar spectrum (spectrum *B*), but with the positions of the bands displaced, is found. It is suggested that below 200° $MoCl_5$ vapour contains associated molecules. W. R. A.

3309. Absorption Spectrum of Oxygen. L. Herman. *Ann. de Physique*, 11. *pp.* 548–611, *May–June*, 1939.—The feeble visible and u.v. absorption spectrum of O_2 has been examined. In the visible spectrum the Janssen bands were detected. The coefficients of absorption were determined, and their variation with the square of the pressure was verified. The importance of this absorption in the atmosphere is discussed. In the u.v., new Herzberg bands were found up to about 3000 Å. This absorption has practically no effect on the limitation of the solar spectrum. The variation of the spectrum with pressure gives an experimental proof of the Herzberg O_2 bands, and the triple bands of compressed O_2. The latter have a very complicated structure and may be ascribed to $(O_2)_2$. An attempt has been made to obtain a common interpretation for the spectra of O_2, O_3, and $(O_2)_2$. A. J. M.

3310. Absorption Spectra of Permanganate, Chromate, Vanadate and Manganate Ions in Crystals. J. Teltow. *Zeits. f. phys. Chem.* 43. *Abt.B.*3. *pp.* 198–212, 1939.—The visible and u.v. absorption spectra of the MnO_4', CrO_4'', VO_4''', and MnO_4'' ions have been observed in dilute mixed crystals with non-absorbing substances at the temperature of liquid H_2. $KClO_4$- embedded MnO_4' ions show 3 u.v. band systems which are made up in the same way as the two band systems in the visible. In the band system II (red spectral region) direction dependence was found; the line corresponding with the pure electron jump appeared only with a certain direction of vibration of the light dependent on the symmetry of the molecule. CrO_4'' ions in K_2SO_4 show also 3 violet and u.v. band systems. VO_4''' ions embedded in $Na_3PO_4,12\ H_2O$ show broad u.v. absorption maxima which lack band structure. For the isoelectronic ions MnO_4', CrO_4'', and VO_4''' a displacement of the long-wave absorption to shorter wave-lengths is evident with decreasing atomic number, *i.e.*, with increasing radius of the central ion. The absorption of these ions is attributed to homopolar transitions within the 3d-shell. The u.v. absorption spectrum of the MnO_4'' ion embedded in K_2SO_4 shows additional band systems. [See Abstract 4537 (1938).] W. R. A.

3311. U.V. Reflection Spectra of Polymorphous Solids. A. Berton. *Comptes Rendus*, 208. *pp.* 1898–1900, *June* 12, 1939.—In absorption spectra by reflection from powders [see Abstract 3718 (1938)], a difference is evident in the u.v. absorption of different forms of the same solid bodies. The form with the most intense absorption towards long wave-length is usually the least dense, the most unstable towards heat, the most stable in ordinary solvents, and the most active from the chemical viewpoint. This is illustrated with reference to anthracene and dianthracene; acetaldehyde (liquid), paraldehyde and metaldehyde; wurzite (hexagonal ZnS) and zinc blende (cubic); vitreous and octahedral arsenious oxide; orthorhombic and cubic antimony and bismuth oxides; rutile and anatase (both quadratic titanium oxide). W. R. A.

3312. U.V. Absorption Spectra of 1–3 Cyclohexadiene. V. Henri and L. W. Pickett. *J. Chem. Phys.* 7. *pp.* 439–440, *July*, 1939.—The intense absorption of 1–3 cyclohexadiene in the region 35000–45000 $cm.^{-1}$ has been measured in the vapour and in hexane solution, and characteristic frequency difference of the band maxima noted. Values of oscillator strength obtained from these data are consistent with theoretical predictions, but the f value found from the solution agrees better with that from the vapour if the correction for Lorenz-Lorentz forces is not applied. AUTHORS.

3313. Kinetics of OH Radicals Determined by Their Absorption Spectrum. Part V. Spectroscopic Determination of a Rate Constant. O. Oldenberg and F. F. Rieke. *J. Chem. Phys.* 7. *pp.* 485–492, *July*, 1939.—In order to determine the efficiency with which triple collisions bring about the recombination of free OH radicals, the rate constant for the reaction must be known in *absolute* units. Consequently it is necessary to measure in absolute units the "standard concentration" on which is based the rate constant previously determined spectroscopically by Frost and Oldenberg. For this purpose the intensities of the OH absorption lines in their "standard discharge" were measured and combined with the f values recently published. Because of the very small width of the OH absorption lines in the discharge, Fabry-Pérot plates had to be used in order to produce absorption spectra with a resolution sufficiently high for suitable intensity measurements. It was found that the efficiency of triple collisions is higher than unity if the number of such collisions is computed from gas kinetic data. This result indicates that

OH forms collision complexes which have a lifetime much greater than the duration of bimolecular collisions between stable molecules. [For Part IV see Abstract 309 (1939).] AUTHORS.

3314. CN and AlO Bands in Study of Carbon Arc. N. R. Tawde and S. A. Trivedi. *Phys. Soc., Proc.* 51. *pp.* 733–740, *July*, 1939.—A systematic study of the problem of the simultaneous excitation of two band systems in the same source has been made by measuring the gross intensity-distribution in the AlO blue-green and CN violet systems in the carbon arc. The results have been applied to the interpretation of the relation between the vibration temperature and rotation temperature in this particular source, in the light of the results obtained by Ornstein and Brinkman. The ratios of the excitation temperatures of the CN system to those of the AlO system measured simultaneously in the same source have been examined and compared with corresponding ratios for C_2 to CH derived by Lochte-Holtgreven under similar conditions. It has been concluded that in the case of simultaneous excitation, so long as the molecules remain the same, the ratio of their temperatures remains practically constant, irrespective of the conditions. AUTHORS.

3315. Modes of Vibration of Normal Aliphatic Chains. J. Barriol. *J. de Physique et le Radium*, 10. *pp.* 215–216, *May*, 1939.—Theoretical. Although it has been impossible to account satisfactorily for all the vibrations attributable to normal aliphatic chains these seem to consist of (*a*) those in which the molecule behaves as the seat of a system of stationary waves, and (*b*) those in which the chain terminal groupings play the important rôle. W. R. A.

3316. Dissociation Schemes for Diatomic Hydrides and Deuterides. E. Hulthén. *Zeits. f. Physik*, 113. 1–2. *pp.* 126–133, 1939.—Recently Gerö and Schmid [see Abstract 2105 (1939)] have attempted to derive the term schemes for hydride and deuteride molecules from atomic term combinations in which the normal state of the metallic atom does not occur, and their work is opposed to the earlier investigations of Hund and Mulliken. The present author now puts forward a series of reasons why the electronic terms of the hydrides and deuterides may be so arranged that their normal states may be derived from the lowest atomic term combinations. The particular examples of AlH and AlD are very thoroughly discussed. H. H. Ho.

3317. Dipole-Dipole Resonance Forces. G. W. King and J. H. Van Vleck. *Phys. Rev.* 55. *pp.* 1165–1172, *June* 15, 1939.—London has shown that at fairly large interatomic distances r, the polarisation energy of a molecule composed of two identical atoms varies not as the customary r^{-6}, but rather as r^{-3} in case one atom is in the ground state, and the other is in an excited state which can combine by dipole transitions with the ground level. The present paper is concerned with the size and sign of this dipole-dipole resonance energy obeying the inverse cube law. The sign has no immediate relation to the sign of the exchange and penetration forces which predominate at closer approach. This possibility of a change from repulsion to attraction results in one of the stable levels of the group of first excited states (derived from separate atom configuration S + P for example) having a lip of activation energy before decomposition into atoms. There will also be a " repulsive " state having a shallow minimum at large separations. Molecules of the heavy atoms have an activation lip so large that the whole stable region is above the dissociation energy. Potential curves of this type have previously been derived empirically from spectroscopic analysis in the case of Hg_2 and Cd_2. The lip is less pronounced in lighter atoms but is none the less real, and has experimental confirmation in the Na_2 spectrum. AUTHORS.

3318. Skeletal Modes of Vibration of Long-Chain Molecules. J. G. Kirkwood. *J. Chem. Phys.* 7. *pp.* 506–509, *July,* 1939.—The method of Born, Karman and Blackman, designed for the determination of the normal modes of crystals, offers interesting possibilities in the case of certain polyatomic molecules possessing structural periodicity. The applicability of the method as a means of approximating the skeletal frequencies of the normal paraffin hydrocarbons is investigated. Although the calculations are not carried beyond the qualitative stage, they provide rather illuminating results. AUTHOR.

3319. Centrifugal Distortion of Axial Molecules. Z. I. Slawsky and D. M. Dennison. *J. Chem. Phys.* 7. *pp.* 509–521, *July,* 1939.—The theory of the semi-rigid rotator developed by Wilson and Howard [see Abstract 2745 (1936)] has been applied to the axial molecules YX_3 and ZYX_3. It is found that the change in rotational energy, δW, caused by the centrifugal distortion, can be expressed in terms of the quantum numbers J and K and as a function of the potential constants and the molecular dimensions. The formula is evaluated explicity for NH_3 and ND_3, and for the former is, in cm^{-1}.: $\delta W_{JK}/hC = -0{\cdot}000625\,J^2(J+1)^2 + 0{\cdot}000950K^2\,J(J+1) + 0{\cdot}000799J(J+1) - 0{\cdot}000630K^4 - 0{\cdot}00189\,K^2$. The pure rotation lines of NH_3 and of ND_3 are calculated and compared with the observations of Wright and Randall, and of Barnes. The agreement is very satisfactory. The theory predicts that the rotation lines are multiple. The spacing of this fine structure was too small to be observable in the region mapped by Wright and Randall but should be possible to detect in the case of the higher members of the rotation series. The authors have also calculated the pure rotation spectrum of PH_3 by using Howard's approximate values of the dimensions and force constants of this molecule. The agreement with experimental values is as good as could be expected from such rough data. AUTHORS.

3320. Potential Functions of Methyl Halides. Z. I. Slawsky and D. M. Dennison. *J. Chem. Phys.* 7. *pp.* 522–529, *July,* 1939.—The problem of the potential functions of the methyl halides is re-examined in an attempt to find a function which is both adequate and simple. A valence form of potential was tried which contained four constants: k_1, the C — H elongation; c, the C — X elongation; k_2, the deformation of the H — C — H angle; and k_3, the deformation of the X — C — H angle. It was found that this simple valence potential must be modified by the inclusion of a cross product term between the X — C distance and the X — C — H angle, thus introducing a fifth constant, k_4. The constants k_1 and k_2 were determined from the methane frequencies ($k_1 = 4{\cdot}88 \times 10^5$ and $k_2 = 0{\cdot}443 \times 10^5$) and were taken to be the same for all the methyl halides. By adjusting the three remaining constants it was possible to predict eight quantities, the six fundamental frequencies and two of the fine structure spacings. The agreement with the observed values was satisfactory, the average deviation being less than 1%. AUTHORS.

3321. Coriolis Perturbations in the Methane Spectrum. Part IV. Four General Types of Coriolis Perturbation. H. A. Jahn. *Roy. Soc., Proc.* 171*A*. *pp.* 450–468, *July* 7, 1939.—In this paper a group-theoretical classification is made of the types of Coriolis perturbation which are possible in a tetrahedral molecule. It is shown that there are in all four distinct types of Coriolis perturbation of an infra-red active vibrational level. These arise from a Coriolis coupling of the rotational levels of this F_2 type vibrational level with the rotational levels of A_2, E, F_1 and F_2 type vibrational levels respectively. The E–F_2 type perturbation has been investigated in previous papers and here general formulæ are derived for the matrix elements of the A_2–F_2, F_1–F_2 and F_2–F_2 type perturbations. It is shown that the A_2–F_2 and F_2–F_2 type perturbations do not produce a splitting of the invividual rotational levels, the first causing a displacement of the *Q* branch levels alone and the second a displacement of the P and R branch levels alone. The F_1–F_2 type like the E–F_2 type perturbation produces a splitting as well as a displacement of the rotational levels. The energy matrix determining this splitting is factorised up to the tenth rotational quantum number with the help of group theory. The formulæ given here form the necessary basis for an analysis of any infra-red absorption band of methane. [For Part III see Abstract 1683 (1939).] AUTHOR.

3322. Red Continuum of Hg High-Pressure Discharge. F. Rössler. *Zeits. f. Physik,* 112. 11–12. *pp.* 667–675, 1939.—Theory and experiment indicate that in temperature excitation the light density distribution perpendicular to the luminous arc follows a similar course for both line and continuous radiation. Thus, using excitation energies of known lines, the method of measurement can be standardised and then applied to the measurement of the excitation energies of unknown continuous radiations. This method has been applied to the investigation of the continuous radiation (visible and infra-red border) of the Hg high-pressure spectrum. The continuous radiations are attributed to transitions between excited levels. In particular the red continuum corresponds with the transition $7\,^1P_1\,\Sigma^+ \rightarrow 6^1P_1\,\Pi$ and the blue-green with the transition $7^1P_1\Sigma^+ \rightarrow 6^1P_1\,\Sigma^+$. W. R. A.

3323. Zeeman Effect of Hyperfine Structure of Optically Excited Hg Resonance Radiation. E. H. Collins. *Phys. Rev.* 56. *pp.* 48–51, *July* 1, 1939.—Magnetic fields from 0 to 2000 gauss are applied to the Hg resonance line 2537 Å and the Zeeman patterns for the hyperfine structure determined. The results indicate close agreement with the explanation of Schuler and Keyston. The Paschen-Back effects for the hyperfine structure of the isotopes 199 and 201 are worked out and experimental evidence is offered in support of the hypothesis of Goudsmit and Bacher that the Zeeman effect for the hyperfine structure may be treated in the same manner as the Zeeman effect for the fine structure if the appropriate change in quantum numbers is made. AUTHOR.

3324. Paschen-Back Effect. Part V. Theory of the Effect for Intermediate Coupling. J. B. Green and J. F. Eichelberger. *Phys. Rev.* 56. *pp.* 51–53, *July* 1, 1939.—General spectroscopic theory has been applied to the Paschen-Back effect and simplified methods developed for determining the positions of the energy levels and intensities of lines for cases of intermediate coupling. They are expressed in terms of *LS*-coupling as the zero-order functions. [See Abstracts 3680 (1936), 4963 (1938) and following Abstract.] AUTHORS.

3325. Paschen-Back Effect. Part VI. Ne Spectrum. J. B. Green and J. A. Peoples, Jr. *Phys. Rev.* 56. *pp.* 54–57, *July* 1, 1939.—The methods developed [see preceding Abstract] have been applied to the spectrum of Ne. The transformation coefficients in this spectrum can be easily determined since parameters have been calculated for several of its configurations. When applied to several lines of the $p^5p - p^5s$ and $p^5p -$

p^5d transitions, results are obtained which are in extremely good agreement with observed patterns. AUTHORS.

3326. Variation of Intensity with Direction of Observation in the Stark Effect. H. Kubota. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 899. *pp.* 7–11, *May,* 1939. *In English.*—Relative intensities of lines in the Zeeman and Stark effect are known both theoretically and experimentally for observation parallel or perpendicular to the direction of the external field. An expression has been deduced for observation at an arbitrary angle to the field and compared with experimental results obtained with a lo Surdo tube with rotating axis. F. S.

3327. Stark Effect of Ne II. Y. Ishida, T. Tamura and G. Kamijima. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 900. *pp.* 12–30, *May,* 1939. *In English.*—A quartz lo Surdo tube with Be kathode was used. Several lines were found due to 3 d-*n*x transitions and the Stark effect was found to be similar to that in He. The lower configurations seem to obey normal coupling, but as *n* increases they seem to follow j.j.-coupling. Absolute term values have been calculated. F. S.

3328. Comparative Measurements in the Stark Effect of Deuterium and Hydrogen. W. Steubing, A. Keil and F. Stolpe. *Zeits. f. Physik,* 112. 9–10. *pp.* 560–568, 1939—The Stark effect separations in the two spectra agree to within the error of measurement. The components show asymmetries which can be explained by the fine structure of the levels. In addition, there is a displacement towards the red which cannot be explained by the second-order effect. Some intensity differences are found and it is shown that under certain conditions some D lines are less sharp than the corresponding H lines. R. P.

3329. Stark-Effect Broadening of Hydrogen Lines. Part II. Observable Profiles. L. Spitzer, Jr. *Phys. Rev.* 56. *pp.* 39–47, *July* 1, 1939.—The H-line profiles previously derived for the case of single encounters are integrated over all encounters to yield the observable profiles. The encounters are assumed to be uniformly distributed over different distances of closest approach, and the ions are assumed to have a Maxwellian velocity distribution. Approximation functions allow the integration to be carried through with rigour in the two limiting cases of very fast and very slow encounters, and with a probable error not exceeding 10 % in the more general case. The resultant profiles illustrate quantitatively Margenau's effect—the transition from impact to statistical broadening with increasing line width. The effect of fast electron encounters is shown to be negligible, in general, in comparison with the effect produced by an equal density of slowly moving ions. An evaluation is made of the error produced by the neglect of the inhomogeneity of the ionic field. The final formulæ have a probable error of less than 12 % for most cases of astrophysical interest. [For Part I see Abstract 2546 (1939).] AUTHOR.

3330. Raman Effect in F. D. Poświat. *Acta Physica Polonica,* 7. 4. *pp.* 367–373, 1939. *In German.*—The Raman spectrum of F, dissolved in CS_2 in which $C_{13}H_{10}$ fluoresces relatively faintly, has been investigated. The Raman lines obtained by irradiation with light of wavelength 4358 Å show fluorescence bands situated in the region 4412 – 4683 Å as a background. Values of the wave-numbers of the displaced lines are given. The appearance, characteristic of benzene substitutions in the ortho position, of the vibration frequency of 1025 cm^{-1}. in the scattered spectrum of F, demonstrates the correctness of the structural formula of F as obtained by chemical investigations. G. O. B.

3331. Raman Spectrum of Benzene in Circularly Polarised Light. J. Cabannes and P. Daure. *Comptes Rendus*, 208. *pp.* 1700–1702, *May* 30, 1939.—The Raman spectrum of C_6H_6 has been determined in circularly polarised light, and instead of the degree of depolarisation ρ, the ratio $r = \rho/(1-\rho)$ has been used. This has the advantage that a small variation of ρ gives a large variation of r. A value of r greater than 6 was not observed. Rays of wave-number 606, 849, and 1178 have $r = 5 \cdot 5$; the components of the doublet 1585 – 1604 have $r = 4$; the line 3047 has $r = 2$. Various other lines are classed as polarised or unpolarised. The strong line at 992 is made up of ten components the wave-numbers of which are given. A. J. M.

3332. Raman Effect of $CdBr_2$ Solutions and Complete Raman Spectrum of $CdBr_4$ Ion. M. L. Delwaulle, F. François and J. Wiemann. *Comptes Rendus*, 208. *pp.* 1818–1820, *June* 5, 1939.—Continuing previous work [see Abstract 1249 (1939)] the authors investigate the Raman effect of concentrated solutions of $CdBr_2$ in water, with and without the addition of alkali bromide, and also solutions in alcohols in the presence of LiBr. Four observed Raman frequencies, $\Delta\nu = 53$, 62, 166 and 181 cm^{-1}. are ascribed to the $CdBr_4$ ion, to which a tetrahedral structure is attributed. L. A. W.

3333. Raman Spectrum of Trimeric Phosphonitrile Chloride. A. M. de Ficquelmont, M. Magat, and L. Ochs. *Comptes Rendus*, 208. *pp.* 1900–1903, *June* 12, 1939.—The Raman spectrum of $(PNCl_2)_3$ has been photographed with exposures of from 3 to 200 hours and consists of 15 Raman lines, four of which are polarised. The symmetry of the molecule is therefore D_{3h} in agreement with the conclusions reached on chemical evidence. W. R. A.

3334. Raman Spectra of Iodine Derivatives ($X \cdot CH_2 \cdot I$). W. Bacher and J. Wagner. *Zeits. f. phys. Chem.* 43. *Abt. B.*3. *pp.* 191–197, 1939.—The Raman spectra of methylene chlorobromide, $Cl \cdot CH_2 \cdot Br$, and of the iodine derivatives, $X \cdot CH_2 \cdot I$ ($X = Cl$, Br, I, $CH_2 : CH$, C_6H_5) are recorded, compared and discussed. W. R. A.

3335. Fine Structure of Raman Lines of CCl_4. A. C. Menzies. *Roy. Soc., Proc.* 172*A*. *pp.* 89–94, *July* 19, 1939.—The intensities in the fine structure of the Raman line corresponding to the total symmetric vibration in CCl_4 have been examined quantitatively and are consistent with a Cl isotope explanation, since the analysis leads to an abundance ratio of about 3·15, in good agreement with Aston's value from mass spectra. The total symmetric vibration Raman line (992 cm^{-1}.) in benzene, and the components of the 459 cm^{-1}. line in CCl_4, are considerably wider than the exciting line. AUTHOR.

***3336. Liquid Prism. J. Duclaux and G. Ahier.** *Rev. d'Optique*, 17. *pp.* 417–423, *Dec.*, 1938.—A liquid prism containing a solution of barium mercuric bromide, of refractive index 1·63 and density 3·1, is described. It gives very high luminosity, and the dispersion is six times greater than that of a 60° prism made of heavy flint. When the liquid is agitated by a current of air, the definition is as good as with a glass prism. Large, sectional prisms can be built without loss of definition. C. B. A.

3337. Optical Life in an Atomic Jet Excited by Electronic Bombardment. H. Bruck. *Comptes Rendus*, 208. *pp.* 1805–1807, *June* 5, 1939.—A new method for the direct measurement of the optical life of a large number of atomic levels has been developed, which consists in the observation of the spectrum produced when an atomic jet is bombarded by electrons. Data are recorded for Zn, Cd and Hg. W. R. A.

See also Abstracts 3265, 3266, 3392.

TRANSMISSION.

See Abstract 3153.

VISION.

3338. Visual Resolution and Illumination. S. Hecht and E. U. Muntz. *J. Gen. Physiol.* 22. *pp.* 593–612, *May* 20, 1939.—The resolution of a single opaque line seen against an evenly illuminated background has been studied over a large range of background brightness. It was found that the visual angle occupied by the thickness of the line when it is just resolved varies from about 10′ at the lowest illuminations to 0·5″ at the highest. The relation between background brightness and resolvable angle shows two sections corresponding to rod and cone vision. The effect of diffraction on the light distribution of the retinal image is discussed and its relation to the limit of resolution considered. W. D. W.

3339. Variation of Reaction Time with Intensity and Colour of Illumination. J. Escher-Desrivières. *Comptes Rendus*, 208. *pp.* 1751–1753, *May* 30, 1939.—Experiments are described in which the time taken to perceive and record a simple operation is measured for different levels of diffuse illumination. The time decreases rapidly with illumination until a value of 50 lux is reached, but between 50 and 500 lux, hardly any change is observed. Reference is also made to experiments with blue light. W. D. W.

3340. Concentration of Visual Purple and Sensitivity during Dark Adaptation. R. Granit, A. Munsterhjelm and M. Zewi. *J. Physiol.* 96. *pp.* 31–44, *June* 14, 1939.—Using dark-adapted excised eyes of the Hungarian frog and the decerebrate cat, the size of the electrical retinal response has been measured with an amplifier and oscillograph and, in parallel, measurements have been made of the total quantity of visual purple of single eyes. The rise in sensitivity has been measured during dark adaptation for given intensities and duration of pre-adaptation and for various temperatures, and the results compared with the corresponding increase in concentration of visual purple. It was found that the increase in electrical response lags behind the increase in concentration of visual purple; the rapid rise in sensitivity might not set in until the visual purple had a concentration of 50% of that of the completely dark-adapted eye. With the cat's eye, no electrical response was obtained although there was still a 40% concentration of visual purple. A tentative hypothesis is put forward to explain these facts. W. D. W.

3341. Photochemistry of Colour Vision. F. Weigert and J. W. Morton. *Nature*, 143. *pp.* 989–990, *June* 10, 1939.—Artificial retinae were prepared from frog retinae by imbedding in thin gelatin films the pigments extracted from the retinae. When the films have been exposed to coloured light, a colour sensitivity of extremely small dimensions was observed. Results are given for exposure to different stimuli and are discussed in relation to the physiological processes responsible for colour vision. W. D. W.

See also Abstract 3273.

X-RAYS.

3342. Compton Effect. Part II. E. Góra. *Acta Physica Polonica,* 7. 4. *pp.* 374–390, 1939. *In German.*—In a continuation of earlier work [see Abstract 738 (1939)] the conditions are more closely investigated for the applicability of the method of solution of the usual differential equations for the indirect process. Quantitative conclusions are made possible if the further plausible assumption be made that the duration of the process or the instant of its occurrence are not completely undetermined, but that at least the order of magnitude is given by means of the reciprocal of the half-life of the γ-radiation. From the known values of the latter it then follows that the applicability of the formula developed in Part I and also that of the usual approximate formula on the scattering of high energy γ-radiation from artificial radioactivity, are still dubious. This implies a considerably greater limitation of the region of validity of these formulæ than has hitherto been suspected. G. O. B.

3343. X-Ray Interference in Crystals. G. Molière. *Ann. d. Physik,* 35. 3. *pp.* 272–296, *June,* 1939.—It is shown that by a consideration of the resonance fraction of the current density induced in a crystal by an alternating electromagnetic field, a generalised Laue equation for the interference of X-rays in crystals can be obtained. This equation is valid for the region of anomalous dispersion and also allows of a description of the diffusion of X-rays in crystals due to reflection, refraction and absorption. The coefficients appearing in this equation are given special consideration; in the region of anomalous dispersion they can be represented as Fourier coefficients. Their tensor character and their dependence on frequency are discussed. G. O. B.

3344. Diffraction of X-Rays by Crystals at Elevated Temperatures. G. D. Preston. *Roy. Soc., Proc.* 172*A. pp.* 116–126, *July* 19, 1939.—A description is given of certain diffuse spots which appear on Laue photographs of single crystals of Al, rock-salt and periclase; these spots do not belong to the normal Laue pattern and their intensity increases as the temperature of the crystal is raised to about 500° C. Analysis of the photographs of Al leads to the conclusion that the presence of the diffuse spots can be explained by the thermal vibrations of the lattice, which break the crystal up into groups, consisting probably of an atom and its twelve neighbours. The thermal vibrations cause the interatomic distances to vary slightly from one group to another so that new diffraction maxima, characteristic of the group of atoms, are produced. AUTHOR.

***3345. Theory and Use of Ross Filters. P. Kirkpatrick.** *Rev. Sci. Instruments,* 10. *pp.* 186–191, *June,* 1939.—Resolving power, preferred thickness and balance of Ross filters for X-ray monochromatisation are discussed. It is theoretically impossible to balance two filters of elementary composition because of scattering, *L* limits and *K* jump, even if the absorption coefficients of the two filters vary similarly with wave-length between the limits, which is not known to be the case. It suffices, however, to obtain good balance for wave-lengths near the pass band since others longer and shorter may be relatively reduced by pre-filtration through a filter whose composition is the same as that of the high atomic number member of the balanced pair. The *K* jump balance error may be completely removed by adding a slightly absorbing filter of low atomic number to one member of the pair. By employing a specially designed ionisation chamber Ross filters may be used simultaneously instead of alternately and a considerable gain in speed and accuracy achieved. AUTHOR.

3346. Residual Ionisation of Gases under Action of X-Rays. G. Reboul and F. Perrier. *Comptes Rendus,* 208. *pp.* 1715–1717, *May* 30, 1939.—The residual ionisation in CO_2 after irradiation by X-rays is measured after intervals of about 1 min. and of 15–30 min. After 1 min. the coefficient of recombination is about 10^{-6} but after 15–30 min. it is between 10^{-7} and 10^{-8}. The corresponding mobilities are 10^{-3} and 10^{-4} cm./sec. It is suggested that the ionised gas consists of normal and large ions, the former having a predominant effect when the time interval is short and the latter when it is long. [See also Abstract 1260 (1939.)]
H. J. H. S.

3347. Spatial Distribution of Ions Produced in Air by X-Rays. Parts I and II. H. Küstner. *Ann. d. Physik,* 35. 2. *pp.* 153–192, *May, and* 35. 3. *pp.* 193–227, *June,* 1939.—In previous work the author [see Abstract 655 (1938)] and Block [see Abstract 4574 (1938] have investigated the ionisation produced in a series of cylindrical ionisation chambers by a beam of heavily filtered X-rays. The curves thus obtained have now been analysed mathematically, and it is shown that the complete ionisation distribution round the X-ray beam can be deduced. For each wave-length the ions form two clouds concentric with the beam axis, the inner one due to Compton recoil electrons and the outer one to photoelectrons. Owing to the longer range of the forward scattered electrons the " Compton " ionisation has its maximum on the axis of the beam for all X-ray qualities. The ionisation due to photoelectrons forms a cloud near to, and surrounding the beam axis, and this, in turn is surrounded by a secondary cloud of low density. As the X-ray beam becomes harder the photo-ionisation cloud moves further away from the axis until at about 120 kV + 4 mm. Cu there is a practically ion-free space between the Compton and photo-ionisation clouds. With still harder radiations the photo-ionisation cloud broadens and overlaps the Compton ionisation. The relative contributions of the scattering absorption and photo-absorption, estimated from the curves are in satisfactory agreement with accepted theories. By extrapolating Kulenkampff's relationship between path length and electron energy in kV, and dividing by the factor 1·8, given by Lenard, it is possible to estimate the electron range for any X-ray quality. It is found that the maximum radius of the subsidiary photo-ionisation cloud and that of the Compton cloud are in good agreement with the estimated ranges of the electrons produced by the hardest radiation in the beam. It is thus possible to estimate the size of ionisation chamber required for the measurement of an X-ray beam of any given quality. In Part II using the columnar theory of ionisation as a basis and making a number of simplyfying assumptions, the ionisation distribution in and around an X-ray beam of circular cross-section is investigated. Similar curves to the experimental ones analysed in Part I for an infinitesminal narrow pencil of rays, are obtained. The separation of the ion clouds due to Compton electrons and photoelectrons, observed in the experimental work, is found to have an explanation in the theory. For a given X-ray quality and intensity the ion density within the beam is approximately proportional to the radius r of the beam, whilst outside the beam the density tends to be proportional to r^2 as the distance from the axis increases. For a constant beam area and X-ray intensity, as the X-ray quality is changed, the ion density within the beam is approximately proportional to R, the electron range. It is shown that for any given X-ray beam of known quality producing at a point a known dose rate in r/sec., it is possible to estimate the absolute number of ions/cm^3. at any point in the space surrounding the irradiated point. J. E. R.

3348. Kβ-Rays of Oxides of Mg, Al, and Si, and of SiC ; Origin of Satellites. J. Farineau. *Comptes Rendus*, 208. *pp*. 1725–1727, *May* 30, 1939.—Satellites of the $K\beta_x$ ray of Mg, Al, Si, previously reported, are shown to arise from the presence of their oxides. [See Abstract 3906 (1938).] W. R. A.

3349. X-Ray Sensitivity of Photographic Films at very Low Temperatures. J. Reekie. *Phys. Soc., Proc*. 51. *pp*. 683–688, *July*, 1939.—Experiments have been carried out to determine the sensitivity of photographic films to X-rays when exposures are made with the films maintained at temperatures obtainable with liquid N_2 H_2, and He. The sensitivity at any temperature *T* is defined as the ratio of the exposure times required to produce images of equal density (0·25) by exposures made at room-temperature and at the temperature *T*, the intensity of the radiation being the same for each exposure. It is found that the sensitivity appears to decrease uniformly down to about 100° K., but below that temperature the decrease becomes less rapid, until, at temperature below 20° K., the sensitivity remains practically constant at a value considerably higher than that found for visible light by Berg and Mendelssohn [see Abstract 4492 (1938)]. The results obtained for X-rays are compared with the latter, and it is suggested that the relatively high value found for the limiting sensitivity in the case of X-rays indicates that a considerable number of free electrons must be formed by the absorption of the X-rays while the film is at low temperature. AUTHOR.

3350. Actions of X-Rays on Electrophoretic Mobility of Colloid Particles. J. A. Crowther, H. Liebmann and R. Jones. *Phil. Mag*. 28. *pp*. 64–72, *July*, 1939.—The rhythmical variations in the electrophoretic mobility of colloidal particles under the influence of X-radiation have been studied in a series of gold sols of varying particle sizes. Both the maximum change in mobility and the dose necessary to produce the change increase markedly with diminution in particle size. The change in mobility produced by the radiation varies from 10 % for the largest particles to 50 % for the smallest particles. It is shown that the results are consistent with the hypothesis that the magnitude of the charge gained or lost by the particle during irradiation is independent of its size. The dose required to reduce the mobility of the particles to a minimum is proportional to $(a + z)^{-2}$, where a is the radius and z a constant of about 8×10^{-7} cm. The dose D required to produce a given change in the mobility of the colloidal particles is related to the absolute temperature θ at which the irradiation takes place by an equation of the form $D = A\epsilon^{w/k\theta}$, where k is Boltzmann's constant and w has a value 0·09 eV for graphite and 0·11 eV for gold. [See Abstract 3292 (1938).] AUTHORS.

***3351. Compact Pressure-Insulated Electrostatic X-Ray Generator. J. G. Trump and R. J. Van de Graaff.** *Phys. Rev*. 55. *pp*. 1160–1165, *June* 15, 1939.—A compact, pressure-insulated, electrostatic X-ray generator has been developed for scientific and medical purposes. A major object of the work was the investigation, with a small and thus flexible machine, of the principles and design factors involved in pressure-insulated electrostatic generators with a view to the subsequent development of higher voltages in compact apparatus. The generator is housed in a steel tank 34 in. in dia. and 100 in. high. At air pressures of 11 atm. absolute, 1250 kV X-rays are obtained with target currents of over 1mA supplied by the single 14-in. belt. With Freon gas the same voltages and currents can be obtained at one-third the pressure required with air. The problem of belt charge is analysed and a method is described for controlling the electrostatic fields within the column in order to realise the high charge densities possible at high pressure. The construction of a supporting column of high breakdown strength, and other features of the design are described. At 1250 kV the X-ray intensity per mA of target current is about 340 r./min. at 50 cm. from the target in the direction of the electron beam with 5 mm. of lead equivalent filtration. AUTHORS.

See also Abstracts 3094, 3458, 3460.

HEAT.

CALORIMETRY.

3352. Specific Heat of Nitrobenzene. J. Mazur. *Acta Physica Polonica,* 7. 4. *pp.* 290–304, 1939. *In German.*—By an electrical method, heating- and cooling-curves, and the specific heat (*c*) of nitrobenzene, have been determined at temperatures (t° C.) between 5° C. and 20° C. The values of *c* are given by $c = 0 \cdot 338300 + 0 \cdot 000556\, t$; no anomalous values were observed. J. S. G. T.

3353. Specific Heat of Ethyl Ether. J. Mazur. *Acta Physica Polonica,* 7. 4. *pp.* 318–326, 1939. *In German.*—The specific heat (*c*) of ethyl ether between 20° C. and — 112° C. is found to be related linearly to the temperature (t° C.) in accordance with the equation $C = 0 \cdot 54239 + 0 \cdot 00059563\, t$. Heating- and cooling-curves of the element have been determined, and it has been established that no transformation point characterises liquid ethyl ether; the substance between 20° C. and — 112° C. exhibits no anomalous behaviour. J. S. G. T.

3354. Atomic Heat of Iron from 1·1 to 20·4° K. W. H. Keesom and B. Kurrelmeyer. *K. Onnes Lab., Leiden, Comm. No.* 257*a. Physica,* 6. *pp.* 633–647, *July,* 1939. *In English.*—The atomic heat of iron has been measured between 1·1 and 20·4° K. The results are in agreement with the law $C_v = \gamma T + bT^3$, with $\gamma = 1 \cdot 20 \times 10^{-3}$ cal./mol. deg². and $b = 4 \cdot 70 \times 10^{-6}$ cal./mol. deg⁴. This value of *b* corresponds to a characteristic temperature of 462° K. The value of γ is discussed from the point of view of Stoner's theory. AUTHORS.

***3355. Low Temperature Precision Adiabatic Calorimeter Adapted to Condensed Gases. J. G. Aston and M. L. Eidinoff.** *Am. Chem. Soc., J.* 61. *pp.* 1533–1538, *June,* 1939.—A low temperature adiabatic calorimeter for condensed gases is described. The precision of this apparatus is about 0·05% in specific heat measurements up to room-temperature and about 0·1% for heat of vaporisation measurements close to room-temperature. The heat capacity of liquid methylamine has been determined over the entire range below room-temperature and agrees with previous measurements. AUTHORS.

3356. Thermal Data of Dimethylamine. J. G. Aston, M. L. Eidinoff and W. S. Forster. *Am. Chem. Soc., J.* 61. *pp.* 1539–1543, *June,* 1939.—The heat capacity of dimethylamine has been determined from 11·8° K. to the boiling point. The melting point of dimethylamine is 180·97° K. (− 92·19°) and the boiling point is 280·04° K. (6·88°). The heats of fusion and vaporisation of dimethylamine are, respectively, 1420·1 ± 0·5 and 6330 ± 3 cal./mol. The vapour pressure of liquid dimethylamine over the range 201° K. to the boiling point is given by the equation: $\log_{10}P_{mm\cdot} = -2460\cdot100/T - 8\cdot63900 \log_{10}T + 7\cdot60550 \times 10^{-3}T - 3\cdot51389 \times 10^{-5}T^2 + 5\cdot32410 \times 10^{-8}T^3 + 32\cdot26370$. The molal entropy of the ideal gas calculated from the experimental data at the boiling point is 64·28 ± 0·05 e.u. To bring the value calculated from molecular data into agreement with the experimental value requires a potential of 3460 cal. hindering the internal rotation of each methyl group. The molal entropies of the superheated liquid at 298·16° K. and ideal gas at 298·16° K. and 1 atm. are, respectively, 43·58 ± 0·05 and 65·24 ± 0·05 e.u. AUTHORS.

3357. Thermal Data of CBr_4. K. J. Frederick and J. H. Hildebrand. *Am. Chem. Soc., J.* 61. *pp.* 1555–1557, *June,* 1939.—Employing the method of mixtures, the heat of fusion of CBr_4 was found to be 945 ±25 cal./mol. at the melting point, the heat of transition of the solid, 1420 ± 15 cal./mol. at the transition point, the molal heat capacity of solid II in the interval 25–46·9°, 35·0 ± 0·5 cal./mol., the molal heat capacity of solid I in the interval 46·9 to 90·1°, 42·9 ± 0·3 cal./mol., and the molal heat capacity of liquid CBr_4 in the interval 90·1 to 150°, 36·7 ± 0·5 cal./mol. AUTHORS.

See also Abstracts 3369, 3414.

CONDUCTION.

3358. Distribution of Temperature in a Rectangular Corner. P. Bock. *J. de Physique et le Radium,* 10. *pp.* 241–244, *May,* 1939.—The first part of this mathematical paper consists of a discussion of the distribution of temperature in the corner formed by two half-planes at right angles to each other. The temperature along one face, $y = 0$, is taken to be $e^{i\nu t}\cdot f(x)$ and along the other, $x = 0$, $e^{i\nu t}\cdot g(y)$. Treating these as boundary conditions, a general solution of the equation for the conduction of heat is obtained. The second part considers the distribution of temperature in a quarter of a cylinder of infinite length the distribution along the faces being given. S. W.

3359. Thermal Conductivity of Silica Aerogel. J. F. White. *Indust. and Engin. Chem.* 31. *pp.* 827–831, *July,* 1939.—It has been confirmed that the thermal conductivity of silica aerogel is less than the conductivity reported for still air. An effective method of opacifying the aerogel to radiant heat transfer has been found to be the addition of finely ground silicon. The method of addition of the opacifier, the density of the aerogel, and the particle size of the aerogel affect the conductivity. Tests carried out using aerogel as insulation in a refrigerator have indicated its value for this use. AUTHOR.

See also Abstract 3137.

CONVECTION.

3360. Electro-Convective Cellular Vortices and Band Formations in Gases. M. Luntz. *Comptes Rendus,* 208. *pp.* 1886–1888, *June* 12, 1939.—The author, in collaboration with Avsec [see Abstract 2162 (1937)] had shown that cellular vortices could be produced in a layer of oil enclosed between horizontal plates when a suitable electric field was applied. It is now shown that very similar effects can be obtained when the oil is replaced by a gas. With an air layer from 0·5 to 5 cm. thick an applied potential of from 1000 to 3000 V produced cellular vortices closely resembling those obtained in the presence of a temperature gradient. The corresponding band formation was observed when the gas was forced to flow parallel to the plane of the two electrodes. R. W. P.

See also Abstract 3390.

DILATATION.

3361. Calculation of Coefficient of Expansibility from the Densities of Solutions. F. T. Gucker, Jr., and C. E. Moser. *Am. Chem. Soc., J.* 61. *pp.* 1558–1559, *June*, 1939.—The authors develop a method of calculating the coefficient of expansibility of any solution for which the density is known as a function of the molarity at two different temperatures and have applied the method to urea solutions at 27·5°. Equations are given for the coefficient of expansibility, apparent and partial molal expansibilities. The apparent molal expansibility of urea is about as great as that of a 1–1 electrolyte, although it is a linear function of the first power and not the square root of the molarity. AUTHORS.

3362. Improved Interferometric Procedure with Application to Expansion Measurements. J. B. Saunders. *Bureau of Standards, J. of Research*, 23. *pp.* 179–195, *July*, 1939.—The Fizeau interferometric method, as applied to thermal expansion measurements, has been studied in order to determine the source of some very serious errors and to find means of reducing such errors. Two types of errors were found to predominate. These may be termed (1) error caused by tilting of the spacers under mechanical forces, and (2) error caused by variations in air-film thickness at the contact points. Such errors often amount to 10% and may, under certain conditions, exceed in magnitude 50% of the value sought. In this paper the two types of errors are considered in detail, and a modified procedure is given whereby the errors are reduced to a magnitude comparable to other unavoidable errors, such as those in reading the fringes and in determining the actual temperature of the specimens. AUTHOR.

FUSION AND SOLIDIFICATION.

***3363. Fusion of Graphite in Argon. Triple Point and Provisional Equilibrium Diagram of Solid, Liquid and Gaseous States of Carbon. Part I. J. Basset.** *J. de Physique et le Radium*, 10. *pp.* 217–228, *May*, 1939.—The fusion of graphite in A has been studied at pressures 1–11,500 kg./cm^2. The triple point occurs approximately at 105 kg./cm^2. and 4000° K.; below this pressure carbon sublimes without melting; above this pressure carbon can exist in the solid, liquid and gaseous states. It has not been found possible to determine exactly the variation of the melting point with pressure; the lowering of the melting point under pressure, previously found, is not confirmed; it is now found that it is raised slightly by pressure. Particles of graphite, melted under a pressure of 4,000 kg./cm^2. have a density of 2·25. Crystals of carbon prepared by crystallisation of molten carbon under pressures of 4000–11500 kg./cm^2. possess the graphite structure only. A provisional equilibrium diagram of the solid, liquid and gaseous states of carbon, embodying adjustments necessitated by the present work, is given. Temperatures of the carbon electric arc, given by various experimenters, appear to be considerably above the temperature of sublimation of carbon found in the present work, and appear to be explicable in terms of the occurrence of special phenomena. J. S. G. T.

See also Abstracts 3074, 3075, 3354, 3365.

TEMPERATURE.

3364. Realisation of the International Scale of Temperature Between 0° and 660° C. J. Roliński and Z. Gajewski. *Acta Physica Polonica*, 7. 4. *pp.* 305–309, 1939. *In French.*—The resistances of two Pt thermometers have been determined, at 0° C., 100° C. and 444·6° C. using in each case a Smith differential bridge and a Dieselhorst compensator, in accordance with the recommendation of the Conférence Générale des Poids et Mésures (1933). Differences of measurement observed by the two devices were of the order 0·001 % to 0·0035 %. Values of the freezing point of Sb derived from observations made with the two thermometers were 630·50° C and 630·53° C.; the accepted temperature is 630·50° C. J. S. G. T.

3365. Diphenylmethane as Thermometric Standard. T. de Vries and H. A. Strow. *Am. Chem. Soc., J.* 61. *pp.* 1796–1798, *July*, 1939.—The use of diphenylmethane as a thermometric standard in the neighbourhood of 25° was investigated. The melting point of purified diphenylmethane was determined to be 25·09 ± 0·01°. Seven junction thermels were used. A spontaneous decomposition occurs, which is accelerated by the presence of light, and causes lowering of the melting point over a period of time. AUTHORS.

3366. Reproducibility of Pt Thermocouple at Freezing Points of Au, Ag and Sb. M. de Selincourt. *Phys. Soc., Proc.* 51. *pp.* 695–709, *July*, 1939.—The investigation deals with the reproducibility of the standard Pt couple at the three points, *viz.*, the freezing points of Au, Ag and Sb, at which it is calibrated for the realisation of the international temperature scale from 660° to 1063° C. The factors limiting reproducibility are considered under three heads, namely, electrical measurement, temperature conditions in the furnaces containing the ingots, and homogeneity of the thermocouple wires. The electrical measuring unit is found to be adequate for an accuracy of the order of ± 0·01° C., whilst in connection with the other two factors improvements have been made which render such an increased accuracy just attainable as an upper limit. In conclusion it is considered that the quality of the thermocouple wires, particularly in relation to their state of strain, constitutes the main obstacle to an increase in reproducibility beyond the normal limit of ± 0·1° C. AUTHOR.

***3367. Colour-Temperature Meter. E. M. Lowry and K. S. Weaver.** *Phot. J.* 79. *pp.* 413–417, *June*, 1939.—Recent advances in colour photography have made it necessary to have an instrument for the rapid and easy determination of the colour-temperature of any light source. The paper describes such an instrument which depends on the matching of a spectral region in the neighbourhood of 580 mμ (given by a yellow filter) with the mixture given by a dichroic filter having maximum transmissions at about 520 and 680 mμ respectively. The transmissions of the filters are adjusted so that there is a colour match and brightness match when looking at a source having a given colour temperature. A colour match may be obtained with a source of higher colour temperature by inserting a yellow filter of suitable density. In the complete instrument this yellow filter is in the form of a circular wedge which can be rotated in front of the matching field. The position of match for a source of known colour-temperature is determined by each observer separately and the colour temperature of any other source is found from the angle through which he has to turn the wedge in order to restore the colour match. J. W. T. W.

See also Abstracts 3380, 3381, 3392, and
758B. Determination of Temperature by Resistance Measurement. J. Wennerberg.
1069B. Resistance Thermometers for Various Purposes. E. Walter.

THERMOCHEMISTRY.

3368. Heats of Combustion of Mono- and Disaccharides. T. H. Clarke and G. Stegeman. *Am. Chem. Soc., J.* 61. *pp.* 1726–1730, *July,* 1939.—A brief description of a precise calorimetric system for measuring heats of combustion and the standardisation of the apparatus with a precision of 0·009 % are presented. The heats of combustion, reduced to the standard state $-\Delta U_R$, are reported as: *l*-sorbose, — 670·30; β-*d*-levulose, — 671·70; α-*d*-galactose, — 666·76; β-lactose, — 1345·47 β-maltose mono-hydrate, — 1360·50; α-lactose monohydrate, — 1354·66; kg.cal./mol. for the constant pressure process at 25°. A comparison of these results with older values in the literature shows discrepancies of from 0·1–1 %. AUTHORS.

3369. Specific Heats of Aliphatic Acids and their Ammonium Salts and Atomic Heat of Nitrogen. S. Satoh and T. Sogabe. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 907. *pp.* 97–105, *June,* 1939. *In English.*—The mean specific heats of oxalic, succinic, pyrotartaric, and tartaric acids and their ammonium salts were determined. The atomic heat of N was deduced from the difference between the molecular heats of ammonium salts and their respective acids. It was found that the atomic heat of N is about 1·8 in some cases, about 6·4 in other cases and generally about 4·2 which is not far removed from the value 3·5 provisionally determined from the study of various nitrides. [See Abstract 2148 (1939).] AUTHORS.

3370. Spontaneous Inflammation of Hexane. E. Fréling and P. Laffitte. *Comptes Rendus,* 208. *pp.* 1905–1907, *June* 12, 1939.—The ignition temperature of mixtures of air and normal hexane have been determined at pressures below 760 mm. The curves of ignition-temperature against pressure arc of the usual parabolic shape. In a 7 % hexane mixture and between 270° C and 400° C. there are " cold flames," blue and quiet, and above 440° C. there are normal flames which are very bright. Similar results, but between different temperature ranges are obtained when the composition is changed to 1·5 % hexane. Between 400° C. and 450° C. a region of luminescence is observed. In mixtures below the stochiometric one (2·16 %) a new type of flame has been discovered. It occurs at high temperatures and low pressures. These flames are blue and quiet and have very long lags—as long as 70 min. The regions of these flames are indicated on an ignition-temperature and pressure diagram. G. G.

3371. Inflammation of Gases by Hot Particles. S. Paterson. *Phil. Mag.* 28. *pp.* 1–23, *July,* 1939.—An apparatus is described for investigating the effect on the ignition of gases by hot surfaces, of the relative motion of the gas and the surface. A coal gas and air mixture was

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used and was ignited by means of heated spheres either of fused silica or of Pt. There is a minimum ignition temperature for a given size of sphere; this temperature is independent of the richness of the mixture, the "age" of the sphere and of its material. For temperatures above this minimum, ignition is always obtained provided the speed of the hot particles does not exceed a critical value. This critical speed increases approximately linearly with the temperature. The slope of these curves decreases with the richness of the mixture and reaches a minimum at a concentration somewhat in excess of that corresponding to maximum flame speed. The igniting power of the Pt spheres improves with use. A simple theory is given which explains the main features, but not all the details of these observations. G. G.

THERMODYNAMICS.

3372. Second Virial Coefficient of He. L. Gropper. *Phys. Rev.* 55. *pp.* 1095–1097, *June* 1, 1939.—Recently a usable expression has been obtained for the second virial coefficient of a monatomic gas. assuming the Einstein-Bose statistics; namely "B" in $pV/RT = (1 + B(T)/V + C(T)/V^2 + \ldots\ldots)$, [see Abstract 258 (1938)]. Massey and Buckingham have made extensive calculations for He on the basis of the Slater-Kirkwood potential [see Abstract 4997 (1938)]. In this paper the Slater-Margenau potential is used as it presumably takes into account the more important van der Waals forces. The final result is a value $B = -123$ at $T = 3{\cdot}708°$ K., the experimental value being $-93{\cdot}6$. It is concluded that the potential must lie between the Slater-Kirkwood potential which gives a smaller well and the Slater-Margenau potential. E. H. D.

3373. Isotherms of Methane-Ethane Mixtures. A. Michels and G. W. Nederbragt. *Physica*, 6. *pp.* 656–662, *July*, 1939. *In English.*—The apparatus used is that of Michels and Nederbragt as modified by Michels, Blaisse and Michels [see Abstract 318 (1937)]; this is illustrated diagrammatically and its use is described, including the calibration. Four mixtures containing respectively 20–40–60–80 mol. % ethane were used at temperatures of 0°, 25° and 50° C. and pressures up to 60 atm. Results are given in tabular and graphical form, and are briefly discussed. E. H. D.

3374. Physical Properties of Compressed Gases. Part VI. Fugacity of CO_2. W. E. Deming and L. S. Deming. *Phys. Rev.* 56. *pp.*108–112, *July* 1, 1939.—The Michels compressibility data for CO_2 are smoothed and interpolated by graphical methods, and the fugacity is computed at certain integral pressures. The temperature range is from 0° to 150° C., and the pressure range from 0 to the neighbourhood of 3000 atm. Along all isotherms, the fugacity at first drops below the pressure, the ratio f/p decreasing with p—a phenomenon well known and explained by the attractive forces of the molecules. The minimum in f/p is reached at or near 600 atm. for all isotherms above critical. With further increase in pressure, the ratio f/p increases, so that the fugacity eventually equals the pressure and thereafter exceeds it. At 50°, $f = p$ at 2435 atm.; 150°, $f = p$ at 1675 atm. [For Part V see Abstract 4323 (1935).] AUTHORS.

3375. General Theory of Heterophase Fluctuations and Pretransition Phenomena. J. Frenkel. *J. Chem. Phys.* 7. *pp.* 538–547, *July,* 1939.—The present paper is a generalisation of a preceding note (*ibid. p.* 200, *March,* 1939) on the statistical theory of condensation phenomena. It is based on the idea that the macroscopic transition of a substance from a phase A to a phase B is preceded by the formation of small nuclei of the B phase within A, these nuclei being treated as resulting from " heterophase " density fluctuations or as manifestations of a generalised statistical equilibrium in which they play the rôles of dissolved particles, whereas the A phase can be considered as the solvent. The application of the general theory to pre-melting phenomena in crystals leads to a quantitative explanation of the abnormal increase of the specific heat of the thermal expansion coefficient (and of the electric conductivity, in the case of ionic substances) in the close neighbourhood of the conventional melting point, with the result that the surface tension between a crystal and its melt must be of the order of 1 dyne/cm. This result is checked by a calculation of the temperature corresponding to the highest crystallisation rate of an overcooled liquid. Transitions of higher order and Curie points are also briefly discussed from the same point of view. AUTHOR.

3376. Elementary Theory of Condensation. F. Cernuschi and H. Eyring. *J. Chem. Phys.* 7. *pp.* 547–551, *July,* 1939.—A theory of liquids is presented based on the assumption of the presence of holes in a lattice-like structure and using a method analogous to that used in treating order and disorder in alloys. This treatment provides an elementary theory of condensation and a clear and simple treatment of the critical phenomena of liquids and also yields a theoretical curve for the density of vapour and liquid as a function of temperature in agreement with the experimental curve. The existence of more than one phase arises as a consequence of the theory. AUTHORS.

3377. Thermodynamics of Strong Electrolytes in H_2O-D_2O Mixtures. Part II. V. K. La Mer and E. Noonan. *Am. Chem. Soc., J.* 61. *pp.* 1487–1491, *June,* 1939.—Measurements of the cell with transference Ag–AgCl/KCl. (m in H_2O–D_2O) /KCl (m in H_2O) /AgCl–Ag have been made at 0·1 m over a wide range of D content and at 5, 25 and 45°. The partial molal free energy, entropy and heat content changes have been evaluated for the process KCl (m in H_2O–D_2O) = KCl (m in H_2O) which corresponds to the process occurring in the cell when the differential transports of the waters is neglected. The absolute activity coefficients of KCl in isotopic mixtures have been calculated referred to KCl at infinite dilution in H_2O as unity. [For Part I see Abstract 1731 (1939).] AUTHORS.

3378. Thermodynamics of Hyponitrous Acid. W. M. Latimer and H. W. Zimmermann. *Am. Chem. Soc., J.* 61. *pp.* 1550–1553, *June,* 1939.—The heat of oxidation by Br_2, the heat of neutralisation, and both ionisation constants of $H_2N_2O_2$ have been determined. These values have been used with the estimated entropies of the acid and its ions to calculate provisional values of the free energies. AUTHORS.

3379. Approximation Formulæ for Work of Reaction and Equilibrium. H. Ulich. *Zeits. f. Elektrochem.* 45. *pp.* 521–533, *July,* 1939.—The work of reaction and equilibrium data can be calculated from purely thermal or spectroscopic data. This is often costly, tedious and unreliable and these new approximation formulæ allow calculations to be made with sufficient accuracy from thermochemical data. The Nernst general approximation formulæ are introduced into the fundamental formulæ of chemical thermodynamics. Three types of approximation can be made: ignoring the variation of reaction entropy with temperature, using specific heats extropolated from values at room-temperatures, using specific heats calculated in an approximate manner allowing for variation with temperature. A mathematical method of carrying out this approximation is also given. G. G.

3380. New Phenomena in Liquid Helium. J. D. Cockcroft. *Roy. Inst., Proc.* 30. 4. *pp.* 800–813, 1939.—Liquid He has long been known to be a curious liquid and it is likely to remain a liquid at the absolute zero, owing to its retaining a zero-point energy of oscillation even at this temperature. There are two kinds of liquid He. Between 4·2° K. and 2·2° K. it behaves like a normal liquid but below 2·19° K. its behaviour is abnormal, expanding on cooling. This form is known as liquid He II and entropy curves show it to be in an ordered state. It is also an extremely good conductor of heat, so much so that special methods have to be adopted for measuring its conductivity. Its heat conductivity has also been shown to vary with the quantity of heat flowing, being greater for small heat flows. The flow of heat in this liquid is also shown to be associated with an actual transfer of momentum. It has also been shown to have a very small viscosity. Various theoretical views as to these effects are discussed. G. G.

3381. Thermomechanical Effect of Liquid He II. H. London. *Roy. Soc., Proc.* 171*A*. *pp.* 484–496, *July* 7, 1939.—The effect discovered by Allen and Jones [see *Nature*, 142. *p.* 643, *Oct.* 8, 1938.] that two reservoirs filled with He II and in communication through a capillary show a difference in hydrostatic pressure, if they are kept at different temperature, is treated thermodynamically. Considering a cycle in which the pressure difference is used to do mechanical work, one finds that reversible thermal effects must appear which are analogous to the Peltier effect. Cold is produced where liquid He II leaves a capillary and heat where it enters. Both are given by the equation $Q = vT(\partial p/\partial T)_{pATA}$, where v is the volume of liquid flowing through the capillary, T the absolute temperature and $(\partial p/\partial T)_{pATA}$ the variation of pressure with temperature in one vessel, if the other is kept at constant pressure and temperature. The hypothesis of Tisza is discussed, according to which the atoms moving through a capillary are apart from lattice vibrations in the lowest energy state. The assumption is made that this process takes place reversibly. One obtains the equation $\rho s = (\partial p/\partial T)_{pATA}$, where ρs is the excess of the total entropy per cm^3. of liquid helium above the part of the entropy due to lattice vibrations. This relation can be used for the experimental verification of the hypothesis. Considering the circulation of liquid set up by the thermomechanical pressure a possible mechanism of heat transport is discussed which allows the correlation of the heat conduction experiments with those on the flow of liquid helium. AUTHOR.

See also Abstracts 3074, 3075, 3110, 3168, 3363.

VAPORISATION AND CONDENSATION.

3382. Optical Investigations on Liquid-Vapour Equilibrium in Capillary Systems. M. B. Coelingh. *Kolloid Zeits.* 87. *pp.* 251–272, *June*, 1939.—Experiments are carried out with a specimen of glass having a surface layer of gel-like character. Liquid films taken up by this layer exhibit interference colours, and these change discontinuously as the surface temperature is altered. Wetting and drying curves are given showing optical thickness of liquid (determined from the observed interference colour) against difference of temperature between the surface and the main liquid from which it is separated by the vapour phase. From the observed steps in the drying curve the radius of the pores is calculated to be of the order of 2 to 20 $m\mu$. Measurements with different liquids give the same pore radius, showing that true capillary condensation is involved. Hysteresis effects are observed and are explained on the view that the liquid meniscus is hemispherical during drying but cylindrical during wetting. L. A. W.

3383. Vapour Pressure and Rate of Evaporation of Barium Oxide. J. P. Blewett, H. A. Liebhafsky and E. F. Hennelly. *J. Chem. Phys.* 7. *pp.* 478–484, *July*, 1939.—The extensive investigations of the rate of evaporation of BaO by Claassen and Veenemans, and Herrmann [see Abstracts 1567 (1933) and 2860 (1937)] are in serious disagreement. In both sets of experiments the oxide was allowed to evaporate from an exposed surface into a vacuum, a method which in this particular case may involve large temperature uncertainties. In the hope of reducing these uncertainties, the method of Knudsen has been applied; in this method the oxide escapes through a small aperture in the wall of a "blackbody" at a rate so small that the equilibrium vapour pressure is not sensibly disturbed. The final results are in agreement with those of Claassen and Veenemans. The vapour pressure of BaO is given by $\log_{10} p(\text{mm Hg}) = 8{\cdot}63 - 19{\cdot}400/T$ (1200–1800° K.). AUTHORS.

See also Abstracts 3213, 3356.

ACOUSTICS.

3384. Dispersion of Supersonic Waves in Liquids. A. K. Dutta. *Bose Research Inst. Calcutta, Trans.* 12. *pp.* 115–123, 1936–1937.—It is known that the velocity of sound waves in a liquid is constant for a range of frequencies from a low value upwards. Within an intermediate region the velocity increases, and thereafter the velocity remains constant with increase of frequency. In a gas the dispersion begins with frequencies of the order 10^5. In liquids such a dispersion has not yet been established, but Kneser has worked out (1938) a general formula for liquids. The derivation in the present paper is for a particular case with known constants. The cause of the change of velocity V is regarded as due to a time-lag between the incidence of the sound energy and the energy of the medium as embodied in the oscillatory motions. A formula is worked out for V^2 and also for V_∞^2/V_0^2. The ratio can be evaluated if certain constants are known. A table is given of the values involved, including those of the ratio V_∞^2/V_0^2 for water and five organic liquids. The curve of V^2 against $\log \omega\beta$ (ω frequency, β a constant) is of the same type as obtained for gases, and the region of dispersion lies in the ω values given by

$\log \omega_0 - \log \omega_\infty = -2$. The frequency for dispersion in liquids is considered to be 10^3 times higher than the value for gases. [See also Abstract 2101 (1938).] G. E. A.

***3385. Reverberation-Time Scale for High-Speed Level Recorder. K. C. Morrical.** *Acoustical Soc. of America, J.* 10. *pp.* 300–301, *April,* 1939.—The determination of the reverberation-time of theatres, auditoria, studios and the like has been much facilitated by the advent of the high-speed level recorder. This instrument, previously described in the literature not only allows the easy determination of the rate of decay of sound energy at any position within the room, but also gives a time picture of the instantaneous sound level at that position. The author dedescribes briefly a scale designed for the rapid reading of the reverberation-time directly from the decay curve recorded by the high-speed level recorder. Constructional details are fully supplied. J. E. B.

***3386. Reverberation-Time Meter. W. M. Hall.** *Acoustical Soc. of America, J.* 10. *pp.* 302–304, *April,* 1939.—Describes a reverberation-time meter of which the principal merits are claimed to be simplicity, speed, precision and portability. No electrical or mechanical connection is required, moreover, to the source of sound used for the measurements, the apparatus being also independent of external power supply. Operation is simple, little experience being needed while general and precision readings appear to be equally feasible. Photograph and diagrams are supplied. J. E. B.

3387. Acoustic Radiation Pressure. J. Mendousse. *Comptes Rendus,* 208. *pp.* 1977–1979, *June* 19, 1939.—It is shown that the mean pressure of sound waves on a boundary-wall is equal to the sum of the Eulerian pressure together with twice the mean kinetic energy for the motion normal to the wall. It is also shown how to calculate the absolute value of the mean pressure. G. C. McV.

3388. Accuracy of König's Formula for Rayleigh Disc. A. C. Merrington and C. W. Oatley. *Roy. Soc., Proc.* 171*A. pp.* 505–524, *July* 7, 1939.—The original object of these experiments was to determine whether the couple acting on a Rayleigh disc suspended in a sound field in air is affected by the viscosity of the air. Since any effect due to viscosity should be relatively more important at low pressures, measurements were made of the way in which the couple varies with pressure. No definite evidence of an effect due to viscosity was obtained, but the experiments brought to light a hitherto unsuspected discrepancy between the measured values of the couple acting on the Rayleigh disc and those calculated from King's corrected version of König's formula. A second series of experiments, in which an accuracy of about 1 part in 200 was attained, served to confim the existence of a discrepancy between theory and experiment. Further tests showed that this descrepancy is to be attributed to the formation of vortices in the medium near the disc. It seems probable that these vortices will nearly always be present under the conditions existing in the normal use of a Rayleigh disc for acoustic measurements. The following empirical equation is proposed to represent the relation between the couple G acting upon the disc, the density of the medium ρ, the mean-square velocity of the medium $\overline{u^2}$, the radius of the disc r and the angle θ between the axis of the disc and the direction of flow of the medium : $G = 1 \cdot 47 r^3 \overline{\rho u^2} \sin 2\theta\, m_1 (m_1 + m_0)$. In this equation m_1 is the mass of

the disc and m_0 its hydrodynamic mass, which is equal to $\frac{8}{3}\rho r^3$. The equation has not been verified for frequencies greater than 50 ~.
AUTHORS.

See also Abstracts
428B. Rayleigh Disc of Resonance Type. M. Kobayashi and T. Hayashi.
677B. Acoustics of Large Auditoria. S. Mollica.
678B. Auditorium Acoustics and Sound Absorption. R. Vermeulen.
680B. Aphonic Room of the G.E.C. Research Laboratory. K. D. McMahan.
683B. Nature and Uses of Supersonics. E. C. Metschl.
1347B. Direct Reading Field Strength and Noise Meter. G. Keinath.
1596B. Logarithmic Recording Device. R. Rogers and F. J. Willig.
1603B. Musical Pitch of Orchestras. G. B. Madella.
1759B. Simple Apparatus for Sound Recording. K. de Boer and A. T. van Urk.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

3389. Precision Measurement of Mutual Conductance of Thermionic Valves. N. F. Astbury. *Journ. Sci. Instruments*, 16. *pp.* 269–272, *Aug.*, 1939.—The paper describes an a.c. bridge method, using mutual inductances, for the measurement of mutual conductance. Multi-electrode valves and valve cascades can be tested, and it is estimated that the value of mutual conductance can be determined with an accuracy of ± 0·002 mA/V. Values of anode a.c. resistance can also be determined incidentally with an accuracy of a few per cent. AUTHOR.

See also Abstracts
756B. New Method of Measuring High Resistance at High Frequencies. M. Saito.
1032B. Measurement of Complex Electrical Resistances at Ultra-High Frequencies. E. Djakov.
1335B. Matrix Method of Treating A.C. Phenomena. S. Noda.

CONDUCTION AND DISCHARGE IN GASES.

3390. Application of Heat Transfer Data to Arc Characteristics. C. G. Suits and H. Poritsky. *Phys. Rev.* 55. *pp.* 1184–1191, *June* 15, 1939.—The chief experimental results of a study of the electric gradient E and current density I in the arc for various gases and pressures [see Abstract 2178 (1939)] can be correlated by means of conduction-convection heat loss data from solid bodies in fluids, and lead to an explanation of the variation of *E* and *I* with current and pressure in good agreement with measurements. This is shown with the help of the Nusselt-type equation, neglecting radiation, and the calculation of relations and evaluation of constant is given, including the cases of forced convection and of arcs in a variable gravity field. N. M. B.

3391. Positive Column of Nitrogen Arc at Atmospheric Pressure E. S. Lamar, A. M. Stone and K. T. Compton. *Phys. Rev.* 55. *pp.* 1235–1244, *June* 15, 1939.—A theory of the positive column in an arc is developed from which good values of nitrogen arc parameters are calculated from known properties of the gas. The power generation per unit volume is obtained in terms of the potential gradient, the electron mobility and the electron concentration. The theory applies only to low current arcs in ordinary space or to arcs below 30 A in gravity-free space. The arc is shown to be free from certain constraints which might otherwise set the temperature, the latter being determined by introducing the additional consideration that the arc operates to make the power loss a maximum. The agreement with experiment is satisfactory. The results supply convincing evidence that the mechanism of the positive column of arcs is now understood. S. A. S.

3392. Variation of Temperature in a Metal-Carbon Arc. H. B. Lobstein. *Physica*, 6. *pp.* 581–585, *July*, 1939. *In English.*—The temperature and the electric force are measured in various phases of a pulsating arc between a metal and a carbon electrode. AUTHOR.

3393. Excitation Functions of Hg. P. Vetterlein. *Ann. d. Physik*, 35. 3. *pp.* 251–271, *June*, 1939.—In determining the yield from inelastic collisions between electrons in a beam and Hg atoms, for the case where the scattered electrons continue in the beam or at a small angle to it, the author claims a much increased sensitivity by the differentiation of the retardation potential characteristic owing to the addition in the circuit of a small alternating potential. By this means the velocity distribution of the electrons in the emerging beam can be measure directly. The electrical excitation functions for the separate Hg levels have thus been determined in the energy range 100–380 V. The sources of possible errors have also been discussed. G. O. B.

3394. Ionisation by Collisions of Positive Ions. J. S. Townsend. *Phil. Mag.* 28. *pp.* 111–117, *July*, 1939.—The author considers the validity of his theory that ionisation by collisions of electrons and positive ions with molecules of a gas explains photoelectric currents and gaseous conductivity in various forms of discharges. Objections advanced on the ground that such ionisation is impossible at higher pressures than the critical value for minimum sparking potential are shown to lead to theories which are themselves unable to explain photoelectric phenomena and corona discharges. It is pointed out that much divergence of opinion exists in modern knowledge of atomic processes, but that the hypothesis is at least not inconsistent with any well-established physical principle. The conductivity of air at high pressures between parallel plates is shown to be consistent with the hypothesis that a molecule is ionised in a small proportion of the total number of collisions of ions with energies greater than 30 V. Recent experiments in H and He at critical pressures for minimum sparking potential, designed to separate the effects of secondary cathode emission and positive-ion ionisation, also support the theory. A. Hu.

***3395. Dispenser Kathode. New Type of Thermionic Kathode for Gaseous Discharge Tubes. A. W. Hull.** *Phys. Rev.* 56. *pp.* 86–93, *July* 1, 1939.—Modern oxide-coated kathodes have the characteristic that the initial high electron emission decreased gradually with time of operation. This characteristic is avoided by using initially-uncoated kathode members to which a coating material is dispensed at uniform rate from a " dispenser " located within the common heat-shield. Such kathodes, after initial ageing, show an electron emission equal to the initial emission of oxide-coated kathodes, which does not decrease with time. In the kathodes which have been tested, the dispenser was a closely woven " stocking " of fine Mo wires, filled with granules of fused BaO — Al_2O_3 eutectic. It was maintained at 1150° C. by current through it, and served as a radiation heater for the kathode. The electron-emitting members were clean Mo. These kathodes show undiminished electron emission at the end of three years life test. **Author.**

See also Abstracts 3083, 3108, 3185, 3243, 3244, 3245, 3250, 3337, 3429, 3430, 3465 and
255B. Fundamentals of Ozone Production in the Electric Discharge. V. Hardung.
738B. Dynamic Characteristics of H.F. Arc Discharge. T. Katayama.
739B. Lowering of Spark Voltage by External Ionisation. C. Brinkmann.
753B. Standard Calibrations for Sphere Gaps. S. Whitehead.
754B. Polarity Limits of the Sphere Gap. F. O. McMillan.
875B. Characteristics of A.C. Mercury Arcs. T. Harada.
1583B. Theory of Glow Discharge. O. Scherzer.

CONDUCTION IN SOLIDS AND LIQUIDS.

3396. Conservation of Momentum in Electrical Conductivity. W. V. Houston. *Phys. Rev.* 55. *pp.* 1255–1261, *June* 15, 1939.—In the theory of the electrical conductivity of metals, the conservation theorem of Peierls establishes the invariance of the sum of the electron wave numbers and a function of the lattice vibrations. This is shown to be accompanied by other related conservation theorems based on the periodicity of the system. One of these refers to the difference between Peierls' integral and the total momentum of the system. The connection between Peierls' integral and the integral of momentum has usually been obscured by the use of electron states that do not represent a definite value of the momentum. When the system is treated as a whole it can be shown that the transfer of momentum from the electrons to the lattice need not be a process involving one electron at a time, but may involve a large number. The *umklapprozesse* can be said to involve a whole group of electrons rather than a single one. As a result the establishment of a steady state in a conducting metal can be understood without considering the *umklapprozesse* of single electrons as introduced by Peierls. **Author.**

3397. Mean Free Path of Electrons in Polar Crystals. H. Fröhlich and N. F. Mott. *Roy. Soc., Proc.* 171*A*. *pp.* 496–504, *July* 7, 1939.—Polar crystals of stoichiometric composition at low temperatures are insulators of electricity. If, however, electrons are raised into the normally empty conduction band of energy levels, either through the absorption of light or the thermal energy of surrounding atoms, the crystals can conduct, and the object of this mathematical paper is to calculate the mean free path of such electrons, and hence their mobility (velocity of drift in unit field). The results obtained are compared with experimental material obtained from semiconductors and from substances which exhibit photoconductivity. In both classes of substance, it is assumed that the electrons in the conduction band have a Maxwell distribution of energies, *e.g.*, at room-temperatures they have kinetic energies of the order 0·04 eV, in marked contrast to the 5 eV for the conduction electrons in metals. A proof is given in the section on lattice vibrations, that the characteristic frequency for longitudinal waves of long wavelength is higher than that of transverse waves (the characteristic vibrations which are excited optically). H. H. Ho.

***3398. Accurate A.C. Potentiometer Measurements. W. Diamand and H. Dziewulski.** *Journ. Sci. Instruments*, 16. *pp.* 264–268, *Aug.*, 1939.—Methods by which the basic values of a.c. potentiometer currents can be accurately established for precision measurements are described. A method which involves the comparison of a.c. and d.c.

of only 10 mA by a bolometric method is described and the difficulties discussed. AUTHORS.

***3399. Feedback Micromicroammeter. S. Roberts.** *Rev. Sci. Instruments,* 10. *pp.* 181–183, *June,* 1939.—A two-stage direct-coupled amplifier circuit with negative feedback which can be used for measuring small direct currents is described. The circuit details are given for a multi-range micromicroammeter which is compact and stable and operates from a.c. power. Through reduction of grid current in the input tube, which is a standard receiving type, it is possible to realise a high sensitivity approaching that of amplifiers using special electrometer tubes. AUTHOR.

***3400. Portable H.V. Supply. R. D. Huntoon.** *Rev. Sci. Instruments,* 10. *pp.* 176–178, *June,* 1939.—A portable power supply capable of furnishing up to 2500 V at 10μA is described. An input of 45 V at 3 mA gives 600 V output with a constancy equal to that of the driving battery. The weight including the 600-V output condenser but excluding batteries is 450 gm. A modification requiring a 90-V supply and weighing 175 gm. is discussed. Possible additional uses such as pulse generator, counting-rate-meter and ignitron control are mentioned. AUTHOR.

***3401. Thermionic Regulation of D.C. Generators. W. E. Danforth.** *Rev. Sci. Instruments,* 10. *pp.* 211–217, *July,* 1939.—In designing electronic equipment for regulation of d.c. generators it is essential to know the effect on the regulated current or voltage of all possible variables in the regulating equipment as well as those in the generator proper. This paper presents, in the static case, a method of treatment which enables one to appraise quantitatively the importance of any source of possible instability in amplifier or generator. The method is applied to two types of regulating equipment, concerning which detailed information is included. AUTHOR.

3402. Threshold and Equilibrium Curves of Supraconductors. J. G. Daunt. *Phil. Mag.* 28. *pp.* 24–33, *July,* 1939.—The threshold values of Sn, Hg and Pb were found from measurements of their resistance. The threshold values were found to agree well with previously measured equilibrium values for Sn and Hg, although there was a marked difference in the case of Pb. It was observed that the change to zero resistance in Pb becomes more gradual as the temperature is decreased, and it is thought probable that quite generally the transition region between the supraconductive and the normal metal loses its abrupt character in high magnetic fields. AUTHOR.

3403. Extrapolation of Conductivities of Strong Electrolytes of Various Valence Types. B. B. Owen. *Am. Chem. Soc., J.* 61. *pp.* 1393–1396, *June,* 1939.—The equation of Onsager and Fuoss is shown to be in formal agreement with the conductivity data for 1–1, 2–1, 3–1, 4–1, and 2–2 valence type strong electrolytes over a limited range in concentrations. It is pointed out that this equation therefore offers a practical means of extrapolating the data for higher valence type strong electrolytes for which accurate activity coefficient data are not available. A simple graphical technique is outlined in some detail. AUTHOR.

3404. Degree of Aggregation of Dyes in Dilute Solution. Part I. C. Robinson and H. E. Garrett. Part II. C. Robinson and J. W. Selby. *Faraday Soc., Trans.* 35. *pp.* 771–784, *July,* 1939.—The conductivity curves of four benzidine dyes, whose micelle formation has been previously studied, have been extended into the very low concentration region. New values have been deduced for Λ_0. For three of these dyes

Λ is found at first to rise considerably above Λ_0 with increasing concentration. This can only be due to micelle formation. By using these new conductivity data, it has been possible to obtain minimum values for n, the number of ions in the micelle, at low concentrations. Osmotic pressure measurements have also been carried out on the $0{\cdot}001\,N$ dye solutions. The values of the van't Hoff factor i so obtained were found to be considerably higher than the values in more concentrated solutions, as was to be expected from previous evidence that these dyes disaggregate on dilution. While at concentrations where the aggregation and included genenions are considerable, the osmotic pressure (in the absence of excess electrolytes) tells us little about the degree of aggregation, at these lower concentrations the osmotic pressures obtained were found to be at least qualitatively in agreement with the aggregation numbers obtained from the conductivity data. Similar results were also obtained on a series of dyes which the authors have referred to as the MC_1 series. From these it will be seen how conductivity data alone can sometimes give information regarding the relative degree of aggregation of a number of closely related dyes. AUTHORS.

See also Abstracts 3416, 3436, 3464, and

265B.	Electrical Measuring Instruments. E. H. W. Banner.
495B.	Standard H.V. Voltmeter with Adjustable Sensitivity. M. Nacken.
571B.	Contact Rectifiers. K. Maier.
1346B.	Voltmeters for Frequencies from 30 ∼ to 200 Mc./sec. J. Lang.
1379B.	Improvement on Rogowski's Magnetic Potentiometer. E. Baum.

DIELECTRICS AND CAPACITANCE.

3405. Energy Relationships of the OH—OH Bond. H. Harms. *Zeits. f. phys. Chem.* 43. *Abt. B.* 4. *pp.* 257–270, 1939.—The mathematical part of the paper contains a calculation of the work to be obtained in the separation of tso associated dipoles against the electrostatic dipole attraction. The electrostatic bond energies thereby derived are found to be in good agreement with the values obtained experimentally, and they enable the molecular physical comprehension of the microscopic properties of materials to be obtained without any special hypothesis being necessary, *e.g.*, in problems of solubility where the energy relationships of the OH — OH bond are concerned. H. H. Ho.

3406. Electronegativity Series of Organic and Bond Radicals Moments. H. C. Brown. *Am. Chem. Soc., J.* 61. *pp.* 1483–1486, *June,* 1939.—The series of organic radicals obtained by arranging the chloro derivatives of these radicals, R–Cl, in the order of increasing values of their carbon-chlorine bond moments is identical with the electronegativity series of organic radicals established by the study of the selective hydrolytic splitting of organo-mercurials. Due to this correlation, it is possible to assign positions in the series to a number of radicals from the reported values of the electric moments of the corresponding chlorides. Among the radicals which can be placed by this means are allyl, vinyl, phenylvinyl, and phenylethynyl. The physical factors, resonance and induction, which have been used previously to interpret the variation in magnitudes of the moments of organic chlorides, appear to be the same factors which determine the electronegativity of organic radicals as measured by chemical methods. AUTHOR.

3407. Dielectric Constant of CO_2 at 25°, 50° and 100° C. up to 1700 Atm. A. Michels and L. Kleerekoper. *Physica,* 6. *pp.* 586–590, *July,* 1939. *In English.*—The measurements on the dielectric constant of CO_2 have been repeated with higher accuracy, so as to allow the

Clausius-Mossotti-function to be calculated also at lower densities. This function passes through a maximum at a density of about 300 Amagat. The results are in agreement with the previous results at higher densities. [See Abstract 2565 (1933).] AUTHORS.

3408. Dielectric Constant of Benzene. W. C. Vaughan. *Phil. Mag.* 27. *pp.* 661–668, *June*, 1939.—The dielectric constant of pure benzene is measured for a frequency of 862·2 kc./sec., the benzene being previously dried for several weeks over sodium wire. A substitution method is used and the test condenser consists of a pair of parallel brass plates. The results obtained at 15·3°, 19·0° and 21·0° C. were 2·2951, 2·2884 and 2·2790 respectively. These values are in satisfactory agreement with previous determinations. [See following Abstract.] A. M. T.

3409. Dielectric Constant, Dipole Moment and Molecular Polarisation of 1·4 Dioxane ($C_4H_8O_2$). W. C. Vaughan. *Phil. Mag.* 27. *pp.* 669–676, *June*, 1939.—The dielectric constant of pure and dry 1·4 dioxane is determined by a method similar [see preceding Abstract]. Measurements are made at seven temperatures ranging from 14·2 to 87·7°C at a frequency of about 1 Mc./sec. Interpolated values are at 25°C. 2·280; at 50°, 2·242. The value of the Clausius-Mossotti factor $F. = (\epsilon - 1)/\rho\ (\epsilon + 2)$ is found to be independent of temperature so that the dipole moment is zero. The molecular polarisability (moment of the doublet induced in a molecule by a field of unit strength) is $1{\cdot}013 \times 10^{-23}$. A.M.T.

3410. Dielectric Polarisation of Solutions of Methyl Alcohol in Dioxane. Dipole Moment of Methyl Alcohol. J. Benoit and G. Ney. *Comptes Rendus*, 208. *pp.* 1888–1890, *June* 12, 1939.—The dielectric constant, ϵ, of solutions of five different strengths of methyl alcohol in dioxane were determined at 12° and at 5° intervals between 20° and 50, and the polarisation P_{12} thence deduced for each case; ϵ at 12° decreases steadily from 4·50 for a solution containing 27·20 % methyl alcohol to 2·44 for one containing 3·82 %, and at 50° from 3·87 to 2·33. The dipole moment, μ, of methyl alcohol is $(1{\cdot}84 \pm 0{\cdot}01) \times 10^{-18}$. C. A. S.

3411. Theory of Electrical Breakdown in Ionic Crystals. Part II. H. Fröhlich. *Roy. Soc., Proc.* 172*A*. *pp.* 94–106, *July* 19, 1939.—Following the ideas on electrical breakdown developed in a previous paper [see Abstract 2785 (1937)] a formula for the breakdown field strength is derived which holds for any kind of polar crystal. This formula makes possible the quantitative calculation of the breakdown field from the optical properties of the dielectric, the dielectric constant and from the molecular volume. The breakdown field F has been calculated for the alkali halides, for quartz and for mica. Satisfactory agreement with experimental values, when they exist, is obtained. It follows from the theory that F should be practically independent of temperature in the case of silicates, in agreement with experiment. For the alkali halides, however, F should increase with increasing temperature. For films thinner than about 10^{-5} cm., F should increase with decreasing thickness. AUTHOR.

3412. Dielectric Strengths of Benzene and Heptane. R. W. Dornte. *J. of Applied Physics*, 10. *pp.* 514–522, *July*, 1939.—The dielectric strengths at 25° C of benzene and of heptane in a uniform electric field produced with a sphere gap and of heptane in a non-uniform field between concentric cylinders, were measured on the pure filtered liquids and with rigorous control of the electrode surface. With any one experimental procedure, the breakdown gradients were reproducible to within 5 % provided all variables were carefully controlled. The most important of these variables, the character of the electrode surface, is influenced by such factors as the degree of polish or etching, adsorbed gas or ions, and the gases dissolved in the electrodes. Adsorbed O_2 or H_2 for example, induces incipient discharges in either liquid with Mo electrodes, but not in heptane with Ni electrodes; in the latter case, the gas adsorbed on the electrodes slightly increases the breakdown gradient. Below 1 atm. the dielectric strengths of benzene and heptane are independent of the pressure. In a non-uniform field, the dielectric strenth of heptane is the same for a.c. and d.c. of either polarity. Although reproducible dielectric strengths were obtained by any one experimental procedure, the results from different procedures varied from 100 to 1700 kV (peak)/cm. It appears, therefore, that the dielectric strengths of pure liquids depend primarily on the nature of the electrode surface which varies with the experimental procedure. AUTHOR.

3413. Thermal Instability of Dielectrics under Continuous Voltages When Conductivity is Dependent upon Field Strength. A. Gemant. *Frank. Inst., J.* 228. *pp.* 79–90, *July,* 1939.—Thermal instability of dielectrics will be considerably influenced by a variation with field strength of the electrical conductivity. The case in which the distribution of the potential across the insulator is controlled by the conductivity alone is dealt with in the present paper. The treatment applies as well to d.c. generally as to a.c. for higher temperatures, thus has a fairly wide range of applicability. The conductivity is taken as a linear function of the field strength, in accordance with experiments, two special cases being dealt with quantitatively. It is shown by numerical computations how the deduced equations have to be used in actual instances. [See also Abstract 2615 (1939).] AUTHOR.

***3414. Thermal Method of Measuring Losses in Sheet Dielectrics at Radio Frequencies and High Electrical Stresses. J. T. MacGregor-Morris and G. L. Grisdale.** *Phil. Mag.* 28. *pp.* 34–63, *July,* 1939.—The measurement of dielectric losses by the calorimetric estimation of the heat produced in a specimen of dielectric when it is subjected to an alternating stress is discussed theoretically. The factors affecting the accuracy of the method are examined; the method is obviously best suited for conditions under which appreciable heat is developed, *i.e.,* when there is a high voltage stress of high frequency. Apparatus is described with which measurements of dielectric losses may be measured by a transient thermal method. Results are given for several of the materials tested. AUTHORS.

3415. New Method of Determining Properties of Dielectrics at Centimetre Wave-Lengths. M. Velasco and G. L. Hutchinson. *Phys. Soc., Proc.* 51. *pp.* 689–694, *July,* 1939.—A new method of measuring the electrical properties of dielectrics at 1 cm. wave-lengths is described. Although this is a free-wave method it requires only relatively small amounts of the substance and is particularly applicable to measurements on solid materials. The method has been employed at a wave-length of 12·0 cm. to determine the refractive indices and the absorption coefficients of some common laboratory substances. The results obtained are given and briefly discussed. AUTHORS.

3416. Kataphoresis in Insulating Media. A. Gemant. *J. Phys. Chem.* 43. *pp.* 743–758, *June,* 1939.—The paper is in two parts, theoretical and experimental. The first deals with various aspects of kataphoresis in insulating media and discusses the different factors in the basic equation, structure of the double layer, and origin of boundary potential. The basic equation is $u = \epsilon\zeta E/4\pi\eta$, where u = velocity of the colloidal particle, ϵ = dielectric constant of the medium, ζ = electric potential between the bulk of the dispersing phase and the phase boundary, E = applied electric field, and η = viscosity of the medium. The second part describes the results obtained on polystyrene suspensions, chiefly in mineral oil, the preparation of the suspensions, the microscopic method of measuring kataphoretic mobilities and the influence on the electrical charge of added electrolytes in the insulating system. S. A. S.

See also Abstracts 3074, 3165, and
26B. Organic Insulating Materials. F. H. Müller.
35B. Electrolytic Condensers. L. Chrétien.
478B. Relaxation Time and Electrical Properties. H. Falkenhagen.

ELECTROCHEMISTRY.

3417. Electrolytes in Mixtures of Water and Organic Solvents. Part I. H. S. Harned and C. Calmon. *Am. Chem. Soc., J.* 61. *pp.* 1491–1494, *June,* 1939.—E.m.f.s at 25° of the cellsH_2 | HCl(m), ROH(X), H_2O(Y) | AgCl–Ag have been obtained for ethanol-water mixtures of 10 and 20%, and for 10% isopropanol-water mixtures. The range of HCl concentration was from 0·005 to 2 M. Densities of the solutions were obtained. The standard potentials of the cells in these mixtures were evaluated with an estimated accuracy of $\pm 0{\cdot}05$ mV. The variation of the standard potential of the cells as a function of the reciprocal of the dielectric constant in these and in methanol-, glycerol- and dioxane-water mixtures is discussed. AUTHORS.

3418. First Dissociation of Carbonic Acid. Y. Kauko and H. Elo. *Zeits. f. phys. Chem.* 184. *Abt.A.* 3. *pp.* 211–230, 1939.—Published experimental work on the determination of the apparent dissociation constant of the first dissociation of H_2CO_3 is critically reviewed. Conductometric measurements by European workers show good agreement and give the value $3{\cdot}5 \times 10^{-7}$ at 25° C. The results of potentiometric determinations by Carlberg are recalculated in the light of the work of Airola on diffusion potentials and good agreement is obtained with the conductometric value given above. This is thought to throw doubt on the conductometric value $4{\cdot}5 \times 10^{-7}$ obtained by American investigators; but the discrepancy remains unexplained. L. A. W.

3419. A.C. Electrolysis of Organic Compounds. J. W. Shipley and M. T. Rogers. *Canad. J. of Research,* 17. *Sect. B. pp.* 147–158, *May,* 1939.—The a.c. electrolysis of a number of organic compounds was carried out in order to ascertain what products might be obtained, what electrolytic conditions affected the nature and the yield of products, and to discover the general relations governing oxidation and reduction when a.c. is used. Oxidation was found to predominate over reduction, owing, probably, to the relatively low H_2 overvoltage on the electrodes. The effect of varying the conditions of a.c. electrolysis was in general similar to that observed in d.c. electrolysis. Satisfactory yields were obtained only when a product of an irreversible process was concerned. A good yield of quinhydrone from the a.c. electrolysis of hydroquinone was secured at a relatively high current density. The chlorination of acetone by the a.c. electrolysis of a solution of acetic anhydride in HCl gave a current yield of 35% at a current density of 2 A/cm^2. AUTHORS.

3420. Electrolytic Migration of Au in Pb-Au Solid Solutions. K. E. Schwarz and R. Stockert. *Zeits. f. Elektrochem.* 45. *pp.* 464–466, *June,* 1939.—Since the diffusion coefficient of Au in Pb is large and accurately known this pair was chosen. An attempt to use a current of 60–80 A through ten 100 × 20 × 0·15 mm. strips in series, immersed in xylol under reflux, was a failure, since the Au was found to have migrated quantitatively into the oxide scale found after passing 4000 F. In a second series of experiments, six or twelve 100 × 0·6 mm. wires were soldered into brass strips mounted in a glass vessel, and cooled by a current of H_2. Anode and kathode portions were analysed separately by shaking with $HgNO_3$, the Hg being removed from the Au amalgam formed, by heating at 300° C. in an air current. In tests with 5·85, 5·54 and 5·84 A, respectively, temperatures of 290°, 265° and 280° C. were obtained ; and definite transfers of 0·062, 0·158 and 0·084 mg. Au occurred. A correction is applied for the end effect of the brass, and from the data, transport numbers of 1·54, 5·1 and $9 \cdot 1 \times 10^{-10}$ are deduced for the conditions employed (2000 A/cm². equivalent to 0·1 V/cm. in electrolysis) ; these are not inconsistent with a formula previously proposed [see Abstract 4176 (1937)] if Au is taken as neutral, but do not agree if Au is regarded as charged.

D. R. H.

3421. Activity Coefficients and Transport Numbers of $ZnBr_2$. H. N. Parton and J. W. Mitchell. *Faraday Soc., Trans.* 35. *pp.* 758–765, *July,* 1939.—Measurements are reported of cells with and without liquid junction containing aqueous solutions of $ZnBr_2$ from 0·02 *M* to 16 *M* at 25° C. A value for the standard potential of the Zn electrode has been obtained, and the activity coefficients of $ZnBr_2$ calculated and compared with the data for similar salts. The transport numbers of $ZnBr_2$ solutions have been calculated and discussed. AUTHORS.

3422. Ag-Ag_2CO_3 Electrode. P. Demers. *Canad. J. of Research,* 17. *Sect. A. pp.* 77–81, *May,* 1939. *In French.*—The electrode was prepared by electrolysing a dilute solution of $NaHCO_3$ with an Ag electrode [see Abstract 2029 (1929)]. With the cell − Ag, AgCl | Na_2CO_3 (m_1), $NaHCO_3$ (m_2), NaCl (m_3) | Na_2CO_3 (m_1) $NaHCO_3$ (m_2) | Ag_2CO_3, Ag + (m_1, m_2, m_3 being the concentrations), at 25° the normal potential of the Ag, Ag_2CO_3 electrode is − 0·4769 V, and the solubility product $1 \cdot 27 \times 10^{-11}$. C. A. S.

See also Abstract 3115.

ELECTRONS, NEUTRONS, POSITRONS AND PROTONS.

3423. Theory of Proton. F. J. Wiśniewski. *Acta Physica Polonica,* 7. 4. *pp.* 310–317, 1939. *In French.*—The proton is conceived as constituted of a positron moving in a circular orbit about a neutron, the attractive force varying inversely as the 4th power of the distance between neutron and positron, and directly as the product of their masses. Values of the magnetic moments of the proton, neutron and deuteron in accordance with experimental values are deduced. J. S. G. T.

3424. Magnetic Moment of Proton. J. Solomon. *Comptes Rendus,* 208. *pp.* 1795–1797, *June* 5, 1939.—Values for the magnetic moment of the proton obtained from the deviation of H_2 molecules in an inhomogeneous magnetic field, and from the determination of the magnetic field necessary to produce a certain degree of decoupling of the spin of the electron and proton, do not agree. It is shown that the direct interaction between proton and electron may explain this discrepancy. A. J. M.

3425. Revaluation and Analysis of Discrepancy in Atomic Constants. F. G. Dunnington. *Rev. Modern Physics*, 11. *pp.* 65–83, *April*, 1939. AUTHOR.

3426. Materialisation of Energy. A. M. da Silva. *Ann. de Physique*, 11. *pp.* 504–547, *May–June*, 1939.—Repetition of experiments first conducted by Skobelzyn and Stepanowa [see Abstract 1252 (1935)] gives that the effective cross-section of the materialisation of the kinetic energy of β-rays of RaC is $0 \cdot 8 \times 10^{-22}$ cm^2., about half the value formerly obtained. Anomalies observed by other workers are ascribed to faults in apparatus. The materialisation of a photon in the field of an electron has been observed. The energy of the materialised photon is 2·65 eMV, photons of this energy content being particularly abundant in the spectrum of RaC. A. J. M.

3427. Scattering of Fast Neutrons. H. Aoki. *Phys. Math. Soc., Japan, Proc.* 21. *pp.* 232–250, *May*, 1939. *In English.*—Absorption-scattering cross-sections of many elements for neutrons of different energy from about 2·1 to 2·8 eMV are determined. Complicated dependences of the cross-sections upon the neutron energy have been observed. The cross-section of hydrogen was compared with theory. Differential scattering cross-sections are determined for H, C, Al, Fe and Pb at the mean scattering angle of about 40°. From the results, it is expected that the angular distribution of scattered neutrons is far from isotropic in the cases of Al, Fe and Pb referred to the laboratory system and in the case of H referred to the system in which the centre of gravity is at rest. The scattering by carbon is expected to be an isotropic one. AUTHOR.

3428. Electron Interference by Light Molecules. P. P. Debye. *Phys. Zeits.* 40. *pp.* 404–406, *June* 1, 1939.—This paper describes a continuation of previous work [see Abstract 1371 (1939)]. The sector method has been developed further and the determination of the position of H-atoms can be regarded as solved. The theory of this method is further discussed, as is also the designing of the sectors. Photographs are given which were made with a voltage of 25 kV. which corresponds to a wave-length of 0·0765Å. The corresponding photometric records are also reproduced. These photographs are made from CCl_4, CS_2, C_2H_2, and NH_3. G. G.

3429. Electron Scattering and Plasma Oscillations. H. J. Merrill and H. W. Webb. *Phys. Rev.* 55. *pp.* 1191–1198, *June* 15, 1939.—The dependence of electron scattering on plasma oscillations was studied, for low vapour pressures and small arc currents, in a Hg arc discharge tube containing a movable probe. Probe volt-ampere characteristics showed the presence of ultimate electrons with a Maxwell-Boltzmann distribution corresponding to about 30000° K. and a superposed stream of fast electrons emitted from the kathode, and scattered in narrow planes. A study of the plasma oscillations showed also narrow regions in which large stable periodic oscillations were detected, equal generally in number to, and coinciding approximately with the scattering regions. The observed frequencies agreed well with the Tonks-Langmuir formula. The two regions became less marked and moved towards the kathode as either vapour pressure or arc current was increased. The periodic oscillations were found only in regions traversed by the fast electrons. Results are interpreted as showing that scattering is due to plasma oscillations which receive their energy from the fast electrons. N. M. B.

3430. Bombardment of Metal Surface by Fast Electrons. J. J. Trillat and R. Mérigoux. *J. de Physique et le Radium*, 10. *pp.* 245–

249, *May*, 1939.—If a metal plate is bombarded with a narrow beam of fast electrons (20–60 kV), the region bombarded becomes visible to the naked eye, and is rendered chemically passive; the electron diffraction diagram previously exhibited by the metal itself also vanishes. Experimental results are given for various conditions, *e.g.*, different electron speeds. The observations are interpreted as resulting from the deposition on the metal of carbon from hydrocarbons which are always present in apparatus containing greased joints. This phenomenon should therefore be borne in mind in connection with all electron diffraction experiments.

E. E. W.

3431. Electronic Emission by Bombardment of Al_2O_3 by Electrons or Negative Ions (H^-, N^-, O^- and O_2^-). A. Bojinesco. *Comptes Rendus*. 208. *pp*. 1800–1802, *June* 5, 1939.—A thin layer of Al_2O_3 prepared electrolytically, was introduced into a vacuum tube and bombarded with negative electrons or ions. The Al_2O_3 layer was carried by the sheet Al on which it had been formed. Shortly after the start of the bombardment and with a low voltage on the cylinder used for collecting the secondary electrons emitted by the surface, the emission begins to grow and reaches a high value. It continues long after the bombardment is stopped. This effect is identical with that first observed by Malter for a thin layer of CsO deposited on Al_2O_3. If the collector voltage is slowly increased during the bombardment, scintillations are observed on the surface whose number and brilliance become greater as the voltage rises. Further increase of the voltage causes the scintillations to disappear and they are replaced by a very brilliant single luminous point, which fades away only to reappear in another place, this effect occurring almost periodically. All the observed effects indicate a new type of electronic emission, different from ordinary secondary emission and produced by an intense positive electric field in the Al_2O_3 layer, the field being great enough to extract the free electrons from the Al surface below the layer and give them velocities great enough to traverse and leave the layer. The intensity of such a field is of the order of 7×10^6 V/cm. for a layer thickness of 10^{-4} cm, 1000 V accelerating potential and 300 V collector potential. The mechanism of the production of such a field is discussed. A. W.

3432. Technique of Measurement of Secondary Electron Emission. W. Majewski. *Acta Physica Polonica*, 7. 4. *pp*. 327–339, 1939. *In French*.—Experimental data concerning secondary emission found in technical and scientific publications are often in complete disagreement. This appears to be due not only to the great complexity of the phenomena observed, but also to the fact that different methods of measurement may give results which do not admit of comparison. It thus seems very desirable to concentrate more attention on the technique of such measurements. Several methods are here examined from the point of view of their convenience and the facility of varying the values of the different parameters which come into play. General indications are then given to assist in the choice of the most suitable method for precise measurements. The author has constructed two types of lamps for the study of secondary emission. The first of these is based on considerations given by Habann and on the kathode ray oscillograph, while the second resembles the dynamic multiplier of Farnsworth. Preliminary measurements made with these lamps are described and applications are suggested for the study of secondary and also of photoelectric emission. A. W.

3433. Electron Distribution in Electron-Optically Focused Electron Beams. L. Jacob. *Phil. Mag.* 28. *pp.* 81–98, *July*, 1939.—A method is described for obtaining the electron distribution in a focused beam. The image size is obtained from this under a certain convention which is described. The electron distribution follows a Gaussian law. The image size decreases with decreasing modulation and with increase in first accelerator voltage. A variation of 5% in focus voltage can increase the image size in the ratio of 2/1. Variation in kathode temperature in the range (900–1075)° C. causes little change in image size over three-fourths of the modulation range. The peak current density of the image is about 50 mA/cm^2. This is one-eighth the theoretical value deduced from Langmuir's formula. The slit width (used in the method) introduces an error of some 10% at the lowest modulation, where ratio spot width/slit width $\doteqdot$ 5. AUTHOR.

3434. Spherical Aberration of Electrostatic Lenses. E. Gundert. *Zeits. f. Physik*, 112. 11–12. *pp.* 689–690, 1939.—An apparatus is described for measuring the spherical aberration of an electrostatic lens consisting of two adjacent cylinders. The diameters of the cylinders are varied and a curve is obtained showing the aberration for different ratios of diameter. The aberration is a minimum when the ratio is 1. [See also Abstract 5220 (1935).] H. J. H. S.

3435. Intensity of Neutrons of Thermal Energy in Air at Sea Level. C. G. Montgomery and D. D. Montgomery. *Phys. Rev.* 56. *pp.* 10–12, *July* 1, 1939.—The number of α-particles released in the disintegration of B by neutrons in the atmosphere was measured in an ionisation chamber filled with BF_3. Assuming a cross-section for the $n - \alpha$ reaction of 3×10^{-21} cm^2., the flux of neutrons of thermal energy was found to be $0{\cdot}091 \pm 0{\cdot}007$ cm^2./min., or one thermal neutron for every 16 ionising cosmic rays. The consequences of the formation and absorption of this intensity of neutrons are discussed. AUTHORS.

See also Abstracts 3146, 3149, 3466, 3472, and

504B. Principles and Construction of Kathode-Ray Oscillographs. M. Demontvignier.
766B. Electronic and Scanning Microscopes. A. Stäger
1044B. Kathode-Ray Oscillograph. Literature References up to 1939. A. Bigalke.
1362B. Measurement Applications of Kathode-Ray Oscillographs. M. Demontvignier.

ELECTROSTATICS.

3436. Effect on Electrometer Performance of High-Resistance Film on Strings. H. Benndorf and E. Rumpf. *Akad. Wiss. Wien, Ber.* 147. 2*a*. 9–10. *pp.* 421–448, 1938.—The phenomenon of creep in sensitive string-electrometers of the Lutz-Edelmann type is investigated. Two experiments are described. In the first experiment three steps are taken: (i) the string and the knife edges are earthed for half an hour; (ii) the string is charged for 20 min. to a potential of 100 V with the knife edges earthed; (iii) the string is again earthed simultaneously with the raising of the knife edges to certain potentials found to cause the least deflection of the string. In these circumstances the string does not in the third instance remain at zero potential but acquires a small positive potential which gradually disappears before the string returns to the zero setting found in (i) above. In the second experiment, the string is (i) charged for 20 min. to a potential of + 100 V; (ii) charged for 1 min. to a potential

of — 100 V; and (iii) earthed simultaneously with raising the knife edges to the same potentials as in step (iii) of the former experiment. In these circumstances the string first shows a small deflection to the negative side, which creeps over to the positive side and ultimately after a time to the true zero. In both experiments the charge acquired by the earthed string cannot be a residual charge from its insulating system. A theory of the electrometer is then developed taking account of the presence of a badly conducting layer on the surface of the string and the existence of a contact potential. The results in the first experiment are explained by a change in the contact potential. The change of contact potential is produced by currents which flow in the badly conducting layer and resembles galvanic polarisation in several respects. Comparison between theory and experiment yields the result that the thickness of the layer is about 10^{-6} cm. and that its conductivity is several times greater than that of air.
T. I. J.

3437. Removal of Electric Charge by Current of Air. O. Yadoff. *Comptes Rendus*, 208. *pp.* 1802–1804, *June* 5, 1939.—The discharge of a conductor by a very rapid current of air has previously been described [see Abstract 1731 (1938)]. Further measurements were made with a brass sphere 35 mm. in dia. subjected to air blasts from a Laval nozzle connected to a reservoir maintained at constant pressure p. The graph obtained by plotting the rate of discharge against the ratio p/p_0 (p_0 being the atmospheric pressure) approximates to two straight lines, the first having only a small slope while the second is much steeper. The air velocity from the nozzle for the pressure ratio corresponding to the intersection of the two lines has a value of 410 m./sec., which can be regarded as the limiting velocity for the slow discharge régime. Above this velocity the rate of discharge increases rapidly with the velocity of the air blast.
A. W.

See also Abstracts **3223, 3351, 3360.**

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

3438. Longitudinal Magneto-Resistance Effect in Fe-Ni Alloys. Y. Shirakawa. *Tohoku Univ., Sci. Reports*, 27. *pp.* 484–531, *April*, 1939. *In English. Report No.* 456 *of the Research Inst. for Iron, Steel and other Metals.*—The change in electric resistance of alloys of the Fe-Ni system at various temperatures ranging from — 195° to 850° was measured up to 1600 oersteds in longitudinal magnetic fields. The specimen used was a fine wire, $0 \cdot 22 \sim 0 \cdot 61$ mm. in dia. and $2 \cdot 6 \sim 7 \cdot 0$ cm. in length. The change in resistance of the alloys of face-centred cubic solid solution on the Ni side is very much larger than that of the alloys of body-centred cubic solid solution on the Fe side, especially at low temperatures. The magneto-resistance—concentration isothermal curves consist of two portions, separated from each other at a concentration slightly above 30% of Ni, and the curves in each portion are concave towards the concentration axis. [See following Abstract.] AUTHOR.

3439. Longitudinal Magneto-Resistance Effect in Fe-Co Alloys. Y. Shirakawa. *Tohoku Univ., Sci. Reports*, 27. *pp.* 532–560, *April*, 1939. *In English. Report No.* 457 *of the Research Inst. for Iron, Steel and other Metals.*—The change in electric resistance of alloys of the Fe-Co system at various temperatures ranging from — 195° to 1150° was measured up to 1600 oersteds in longitudinal magnetic fields. The specimen used was a fine wire, $0 \cdot 20 \sim 0 \cdot 61$ mm. in dia. and $3 \cdot 9 \sim 7 \cdot 1$ cm. in length.

The change in resistance of the alloys of face-centred cubic γ solid solution is very much larger than that of the alloys of body-centred cubic α solid solution on the Fe side and of hexagonal close-packed h solid solution on the Co side, especially at low temperatures. The magneto-resistance—concentration isothermal curves consist of three portions, that is, α-, γ- and h-solid solution ; the curves of α-solid solution alloys are all concave towards the concentration axis. [See Abstract 2234 (1939) and preceding Abstract.] AUTHOR.

3440. Change of Resistance in Magnetic Field. L. Davis, Jr, *Phys. Rev.* 56. *pp.* 93–98, *July* 1, 1939.—The general theory of the Hall effect and the change of resistance in a magnetic field expresses these quantities in terms of a number of integrals over the surface of the Fermi distribution. The values of these integrals depend upon the form of the electron energy and the relaxation time as functions of the wave vector. If the free electron situation is assumed, the Hall effect has the right order of magnitude, but there is no change of resistance. This can be seen from a qualitative consideration of the effect of the fields on the distribution function. A general form for the functions in other cases can be obtained as an expansion in spherical harmonics with the symmetry of the crystal lattice. The results can then be expressed in terms of the coefficients in this expansion. When only the first two harmonics are retained, the computed change of resistance and Hall effect are close to the observed values. However, contrary to the available observations, the ratio of the transverse to the longitudinal change of resistance shows a minimum value of about four. It seems improbable that this result could be changed in any material way by the inclusion of higher series members, so that if the experimental results are to be taken as reliable, doubt is thrown on the general method of treatment. AUTHOR.

MAGNETISM AND ELECTROMAGNETISM.

3441. Explanation of Magnetisation Processes in Ferromagnetic Materials. M. Kersten. *E.T.Z.* 60. *pp.* 498–503, *April* 27, *and pp.* 532–537 ; *Disc.*, 537–538, *May* 4, 1939.—Theoretical discussion of, *inter alia*, remanence, reversible magnetism, initial permeability, coercive force, and hysteresis. W. R. A.

3442. Time-Lag in Magnetisation in Upper and Steep Portions of Hysteresis Loop. J. Ôkubo and N. Yamanaka. *Tohoku Univ., Sci. Reports*, 27. *pp.* 429–449, *April*, 1939. *In English. Report No.* 453 *of the Research Inst. for Iron, Steel and other Metals.*—The observed results of the time-lag in the upper and in the steep portion of the hysteresis loop are reported. The materials tested were Armco iron, electrolytic iron, and electrolytic nickel, and their magnetic permeability in the observed changes of field remained nearly constant. It is shown that the time-lag in the upper portion agrees with Wwendensky-Kiessling's theory of eddy currents, while that in the steep portion is much greater than expected. The causes of this discrepancy are discussed. [See Abstract 5292 (1936).] AUTHORS.

3443. H.F. Magnetic Permeability of Wires and of Thin Plates. N. A. Florescu. *Comptes Rendus*, 208. *pp.* 1717–1719, *May* 30, 1939.—The h.f. permeability of thin Fe wires, magnetised in the direction of the axis, is compared with that of thin Fe plates (80 mμ thick). The permeability diminishes almost linearly with frequency in the wire over the range

80–275 m. but only to a small extent in the plate. The latter, however, is said to contain much oxide as it was prepared by kathodic deposition. H. J. H. S.

3444. Variation in Velocity of Oxidation of Magnetite at Curie Point. R. Lille. *Comptes Rendus*, 208. *pp.* 1891–1893, *June* 12, 1939.—When a mixture of O_2 and N_2 is passed over finely divided magnetite at a constant rate and at varying temperatures, oxidation (measured by the magnetisation), practically ceases after 1 min., but recommences above 600° after an interval of some 30 min. This is probably due to fissuring of the layer of Fe_2O_3 first formed. If magnetisation is plotted against temperature, the heating continuing for 15 min. at each temperature, there are distinct breaks in the curve at 570° and 675°, the Curie points of Fe_3O_4 and Fe_2O_3 respectively. C. A. S.

3445. Magnetic Study of Fe-Ni-Al System. W. Sucksmith. *Roy. Soc., Proc.* 171*A*. *pp.* 525–540, *July* 7, 1939.—A survey of the magnetic saturation intensities of the Fe-Ni-Al system at temperatures up to the Curie point is described, in which over 80 alloys have been examined. It is shown that each phase region exhibits characteristic features, and phase changes can in general be followed by the variation of the saturation intensity. The differences between the saturation intensities of ordered and disordered alloys is examined in various regions of the phase diagram. The more detailed examination of alloys showing special features is in progress. AUTHOR.

3446. Magnetic Properties of Pyrrhotine. S. Kaya and S. Miyahara. *Tohoku Univ., Sci. Reports*, 27. *pp.* 450–458, *April*, 1939. *In German. Report No.* 454 *of the Research Inst. for Iron Steel and other Metals*.—The sample used was a large crystal of pyrrhotine from Asio (Japan). A disc of 10·6 mm. dia. and 1·9 mm. thick was cut parallel to the (0001) plane and the magnetisation and hysteresis curves determined by a torsion balance method for different directions in the crystal. Ease of magnetisation is greatest along the $[11\bar{2}0]$ axis and least along the $[10\bar{1}0]$ axis. The parallel components of the magnetisation vector in the magnetic plane (0001), plotted as a function of the azimuth θ, show beautiful six-fold symmetry, so that the given crystal exhibits hexagonal symmetry in its magnetic anisotropy. The result differs from that of Weiss [see Abstract 1781 (1905)], probably due to the difference in origin of the samples. S. J. G.

3447. Magnetic Properties of Rare-Earth Cobalticyanides. T. Karantassis, C. Vassiliadis and N. Perakis. *Comptes Rendus*, 208. *pp.* 1720–1721, *May* 30, 1939.—The preparation of the cobalticyanides of Yt, La, Sm, Ce, Pr, and Nd is described, and values are given for their susceptibilities and atomic susceptibilities, and in some cases the Curie point and the moment in Weiss magnetons. A. J. M.

3448. Magnetic Flux Distribution for Cylinder of Constant Permeability in Homogeneous Field. Susceptibility of Gd_2O_3 at Low Temperatures. W. F. Giauque and J. W. Stout. *Am. Chem. Soc., J.* 61. *pp.* 1384–1393, *June*, 1939.—An experimental investigation has been made to evaluate factors, so that the magnetic susceptibility may be calculated from measurements of the flux of induction through coils located at various positions about a cylindrical sample. The results apply to a sample with a ratio of length to diameter equal to 4·8 which has been found to be a convenient size for adiabatic demagnetisation experiments.

The susceptibility of Gd_2O_3 was determined by the induction in coils surrounding an ellipsoidal sample. These results were then used to interpret similar observations on a cylindrical sample. The magnetic susceptibility of Gd_2O_3 has been given for various temperatures in the range 1·5–88° K. The investigation was carried out at low temperatures so that a paramagnetic substance of relatively large and field independent susceptibility could be used. Ferromagnetic materials are unsuited for this purpose because of a variable permeability and hysteresis. An equation has been developed so that susceptibility may be deduced from induction measurements with coils located at various positions with respect to ellipsoidal samples. AUTHORS.

3449. Temperature Variation of Magnetic Anisotropy of Bi Crystals. W. J. John. *Zeits. f. Krist.* 101. 4. *pp.* 337–344, 1939. *In English.*—The magnetic anisotropy of Bi crystals has been studied from the room-temperature up to the melting point, with two different specimens, one of 99·998 % purity from Hilger, and the other of lower purity from Merck. For the former specimen the principal susceptibilities along the trigonal axis and perpendicular to it are $\chi_\parallel = -1\cdot 05 \times 10^{-6}$ and $\chi_\perp = -1\cdot 45 \times 10^{-6}$ respectively, per gm. at 27° C, and the anisotropy $\chi_\parallel - \chi_\perp$ is equal to $0\cdot 402 \times 10^{-6}$. As the temperature is raised the anisotropy decreases linearly with temperature, reaching the value $0\cdot 09 \times 10^{-6}$ at 260° C. Beyond this temperature, there is very little decrease, and the anisotropy remains practically constant right up to the melting point, 271°·1 C. With the less pure specimen the anisotropy is $0\cdot 43 \times 10^{-6}$ at 27° C. and decreases linearly to $0\cdot 135 \times 10^{-6}$ at 260° C. Beyond this temperature the anisotropy decreases very rapidly and reaches very low values before the crystal melts. AUTHOR.

3450. Diamagnetic Anisotropy of Organic Molecules. K. Lonsdale. *Roy. Soc., Proc.* 171*A. pp.* 541–568, *July* 7, 1939.—The principal diamagnetic susceptibilities of single molecules of aliphatic and aromatic compounds have been measured and related, where possible, to their dimensions, electronic configuration, optical polarisabilities, magnetic birefringence and other physical properties. It is found that for long-chain compounds containing few or no multiple bonds, the maximum diamagnetic susceptibility and maximum refractivity correspond to the length of the molecule. In molecules of layer structure also containing few or no multiple bonds, the maximum diamagnetic susceptibility and maximum refractivity both lie in the mean plane of the layer, along the direction of greatest length. Both these types of compound show negative magnetic birefringence. In aliphatic molecules containing acetate or acid groups, or chains of conjugated double and single bonds, such groups tend to be plane and show an abnormally large diamagnetic susceptibility normal to the plane of the group. This produces a magnetic anisotropy opposite in sign to that found for aliphatic layer structures containing only single bonds, but similar to that characteristic of aromatic molecules. Aromatic molecules with aliphatic conjugated side chains possess magnetic anisotropy greater than that which would be expected for the aromatic part of the molecule alone. For all these substances, both aliphatic and aromatic, the abnormally large diamagnetic susceptibility corresponds in direction with the minimum optical polarisability. They therefore show a positive, often large, value of the magnetic birefringence. There is at present no theoretical treatment which accounts for diamagnetic anisotropy in any but conjugated ring structures. AUTHOR.

3451. Free Vibration of Bodies in Electrical and Magnetic Fields. W. Braunbek. *Zeits. f. Physik*, 112. 11–12. *pp*. 753–763, 1939. —A mathematical investigation of the problem whether a body or system of bodies in stable equilibrium can be maintained in a state of free vibration by static or stationary electric and magnetic fields. It results that this is impossible if diamagnetic materials are excluded from the system. [See following Abstract.] G. E. A.

3452. Free Vibration of Diamagnetic Bodies in Magnetic Field. W. Braunbek. *Zeits. f. Physik*, 112. 11–12. *pp*. 764–769, 1939.—It is shown that it is possible for a small diamagnetic body to hover or vibrate in a free stable condition if placed in a particular magnetic field. Bi crystals weighing 8 mg. and C particles up to 75 mg. were successfully set in vibration in a field of about 23000 Oe. The period corresponded to that of a pendulum 75 mm. long. [See preceding Abstract.] G. E. A.

See also Abstract 3248, and

780B. Absolute Inductor Magnetometer. G. Filippini.

MEDICAL RADIOLOGY AND ELECTROLOGY.

3453. Measurement of H.F. and L.F. A.C. Conductivity of Living Tissue. J. Dubost. *J. of Radiologie et d'Électrologie*, 23. *pp*. 263–268, *June*, 1939.—With the increasing use of electrical treatment and other medical applications of electricity, precise measurement becomes of increasing importance. Previous work is referred to and the author adopts the " effective resistance " of Lullies, as being rapid and precise. This effective resistance depends on the impedance of the body and the angle of phase. This has been measured by use of Dufour's kathode-ray oscillograph, which is briefly described and illustrated with the electrodes used in the present researches. Various sources of current of high, mean and low frequency have been applied in combination with an amplifier which is briefly described. Typical oscillograph curves are illustrated with their application to the calculation of impedance. The experiments have been carried out on living dogs and frogs. B. J. L.

3454. Human and Mechanical Fallibility in Radiography. H. T. Ferrier. *Radiography*, 5. *pp*. 17–24, *Feb., and pp*. 35–41, *March*, 1939.—In this Melville Memorial lecture the author points out that the adoption of correct techniques is essential in the provision of radiographs which permit reliable interpretation. It is emphasised, for example, that the statement of kV and mA does not necessarily give an indication of X-ray output, that the intensities of X-ray beams vary with angle, and that photographic defects may simulate pathological lesions. Special difficulties are encountered in certain types of radiography, including barium enemas, chests and examinations for rheumatic conditions, and methods of overcoming some of the difficulties are outlined. G. E. B.

3455. Method of Calibrating Roentgenographic Machines. H. Randall and L. F. Black. *Am. J. of Roentgenology and Radium Therapy*, 41. *pp*. 1053–1056, *June*, 1939.—A method is presented for the comparison of the radiographic performance of two X-ray machines. The comparison is made in terms of the radiographic effect rather than the less useful kilovolts (peak). The equipment suggested is simpler than a sphere gap. This method can be used with shockproof equipment. The errors and accuracy are such as to make the method an improvement over the sphere gap method. There are two obvious difficulties: the necessity of having a standard machine, and the necessity of carrying films from one machine to another. In most cases these difficulties are negligible. AUTHORS.

***3456. Physical Principles of Slit Kymography. M. M. Schwarzschild.** *Radiology*, 33. *pp*. 90–107, *July*, 1939.—The physical principles of slit kymography are discussed, with emphasis upon the factors influencing the accuracy of time measurements. This is discussed in terms of the so-called *characteristic time*. The condition for records of maximum readability is given and called the *esthetic* relation. A number of types of movement are studied with the multiple, parallel and equidistant slits. The Cignolini and Morelli methods are discussed briefly. An explanation is offered for the frequently observed phase shift along the cardiac contour. The explanation does not involve peristalsis or screw-like movement, but depends on the assumption that the movement of the heart is a combination of a radial pulsation and an oscillation, these movements being out of phase. AUTHOR.

3457. Ionisation in Air and in Gas Mixtures Approximating Composition of Tissues. R. Naidu. *Am. J. of Roentgenology and Radium Therapy*, 41. *pp*. 992–998, *June*, 1939.—A comparison of the ionisation produced in air and in a gas mixture approximating the atomic composition of human soft tissues has been made with X-rays of effective wave-length ranging from 0·12 to 0·77 Å. The ratio of the ionisation in the gas mixture to that in atmospheric air decreases with increasing wave-length, and the difference is about 22% in the above mentioned range. Qualitatively, the difference may be attributed to the difference in the effective atomic numbers of air and the gas mixture and to the " anomalous " variation of the mass absorption coefficient of H_2 with respect to wave-length in the region of these experiments. Since in radiation therapy it is desirable to express tissue doses in terms of the energy absorbed by the living tissue, ionisation measured in air does not fulfil the necessary requirement in the wave-length range ordinarily used. AUTHOR.

3458. Half-Value Layer Measurements with a 1000 kV X-Ray Tube. T. Lauritsen. *Am. J. of Roentgenology and Radium Therapy*, 41. *pp*. 999–1002, *June*, 1939.—Rough theoretical considerations indicate that the monochromatic equivalent of an X-ray beam, as determined in Cu, may be quite different from that obtained in water for the range of 200 to 400 kV, converging to the water value on both sides of this region. Experiments made at various voltages and with various filters on a h.v. tube show that this disagreement may amount to 20 to 25%. For this reason it is felt that Cu is not a satisfactory material for characterising beams in this range. AUTHOR.

3459. Depth Dose Measurements with a 1000 kV X-Ray Tube. T. Lauritsen. *Am. J. of Roentgenology and Radium Therapy*, 41. *pp*. 1003–1006, *June*, 1939.—Measurements of depth dose at voltages from 100 to 500 kV monochromatic equivalent, corresponding to tube voltages between 200 and 1000 kV, are reported. It is found that there is a definite improvement in dose at 10 cm. from 100 to 200 kV equivalent, but no further increase from 200 to 500 kV, if portals larger than 10 × 10 cm. are used, while the dose at 5 cm. suffers an actual decrease. It is concluded that, as far as depth dose is concerned, there is no advantage in going to tube voltages higher than 400 kV, unless it is possible to reach voltages much higher than 1000 kV. AUTHOR.

***3460. Million Volt X-Ray Outfit. E. E. Charlton, W. F. Westendorp, L. E. Dempster and G. Hotaling.** *J. of Applied Physics*, 10.

pp. 374–385, *June,* 1939.—The apparatus described consists of a l.f. resonance transformer, with a coaxially mounted multi-section X-ray tube within, both contained in an earthed steel tank and employing compressed dichloro-difluoro-methane insulation. The X-rays are generated from a target mounted in an extension chamber projecting from the earthed tank. Full details are given of the transformer, tank, tube, exhaust and compression systems and the electrical circuit. An investigation of the breakdown strength of insulating materials shows the great superiority of the insulating gas used. Methods of measuring tube current and voltage, together with wave forms and power input and output data, are described. X-ray absorption curves in Pb and Cu have been obtained with X-ray beams at 90° and at 0° to the electron beam. The cooling of the transformer is discussed and it is suggested that heat dissipation is the most serious factor limiting the voltages obtainable by this method. J. E. R.

3461. Concrete as a Protective Material against H.V. X-Rays. G. Singer, L. S. Taylor and A. L. Charlton. *Radiology,* 33. *pp.* 68–76, *July,* 1939.—A description is given of relative X-ray transmission measurements on a group of especially prepared concrete specimens and commercial building blocks selected to sample the concrete mixes and cover the range of concrete densities in common use. It was found that the lead equivalent of any concrete was an increasing function of its mass per unit area and independent of the nature of the mix. Relations between lead equivalence, density, mass, and thickness are given, from which the thickness of concrete necessary for adequate protection can be calculated for any voltage in the voltage interval 200 to 400 kV. AUTHORS.

See also Abstract 3347, and

113B. Sterilisation by U.V. Radiation. S. G. Hibben and P. W. Blackburn.
816B. U.V. Air Sanitation. F. W. Robinson.

OSCILLATIONS AND WAVES.

3462. Excitation of Oscillations with a Dynatron in a Circuit with Uniformly Distributed Electrical Constants. W. Majewski. *Acta Physica Polonica,* 7. 4. *pp.* 340–356, 1939. *In French.*—A mathematical study is made of the system formed by a dynatron with a circuit having uniformly distributed constants, the author's aim being to take account of the various phenomena which occur and to establish relations as simple and clear as possible between the different parameters which come into play. From the results obtained it appears that such systems can be employed to stabilise the frequency of oscillations with suitable choice of the circuit dimensions and of the operating point of the dynatron. A. W.

***3463. Kathode-Ray Bunching. D. L. Webster.** *J. of Applied Physics,* 10. *pp.* 501–508, *July,* 1939.—The bunching of kathode rays in the klystron [see Abstract 2656 (1939)] is treated mathematically here, and is found to result in a current having a wave form with sharp peaks and containing strong higher harmonics. In the absence of appreciable "de-bunching" by mutual repulsion, the kinematics of the bunching process leads to specifications for an optimum condition of bunching and to the prediction of an ideal efficiency of 58% for the conversion of the kathode-ray power into h.f. power. De-bunching becomes important under certain calculated conditions, limiting the amplification factors obtainable in amplifiers without regeneration. It also changes the optimum conditions for oscillators and reduces their efficiencies by calculable amounts. The

power required in the buncher is relatively very small and depends on the buncher voltage almost like that of an additional ohmic resistance.
AUTHOR.

***3464. Residual Current in Electrostatic Electron Multipliers. J. Rajchman.** *Arch. des Sciences*, 20. *pp.* 231–264, *Sept.–Oct.*; 267–289, *Nov.–Dec.*, 1938, *and* 21. *pp.* 5–37, *Jan.–Feb.*, 1939.—The first part outlines the principle of the electron multiplier—the magnetic type requires an external magnet which must be carefully adjusted while the electrostatic type is difficult to construct and the space charge causes certain difficulties which limit the output current to a very small value. A new electrostatic type is described employing photoelectric emission; a gain of 10^8 or 10^9 has been observed and the instrument has a very high sensitivity, the output current being proportional to the light intensity; a serious disadvantage is the residual current which flows even when the tube is shielded from all radiation (light, u.v. or infra-red). A full treatment of the methods employed for solving problems in electron trajectory is included, together with results of work done experimentally and on a mechanical model. The second part of the paper deals particularly with the residual current, the causes of which are found to be leakage current between the collector circuit and other electrodes, effects producing positive ions causing ionisation of the gas in the tube, cold emission from the electrodes caused by the electrostatic field and thermal emission from the surfaces. Each of these items is discussed in detail; it is possible partially to suppress the third and completely to suppress the first two. E. O. T.

***3465. Switching Action of the Eccles-Jordan Trigger Circuit. H. Toomim.** *Rev. Sci. Instruments*, 10. *pp.* 191–192, *June*, 1939.—A short discussion of the effect of introducing small capacitances in the Eccles-Jordan trigger circuit [see Abstract 932B (1919)]. L. E.

***3466. Amplification by Secondary Electron Emission. W. H. Rann.** *Journ. Sci. Instruments*, 16. *pp.* 241–254, *Aug.*, 1939.—The experimental data relating to the phenomenon of secondary electron emission from simple and complex surfaces is collected and tabulated. Simple electron multipliers with single stages of multiplication are examined and typical characteristics are shown. A brief description is given of the now obsolete dynamic type. Full details and operating characteristics of multistage electron multipliers using combined electrostatic and magnetic focusing are then given. The final section deals with electron multipliers using only electrostatic focusing. This last group is divided into two classes consisting of multipliers with solid targets and those with grid mesh targets.
AUTHOR.

3467. Diffraction Theory of Electromagnetic Waves. J. A. Stratton and L. J. Chu. *Phys. Rev.* 56. *pp.* 99–107, *July* 1, 1939.—It has been shown by Larmor, Kottler and others that the classical method of calculating diffraction from the Kirchhoff formula in terms of a scalar light function cannot be applied directly to the electromagnetic field since it takes into account neither the vector character of the field nor the effect of charges along the contour of the opening. The field equations are integrated directly by means of a vector analogue of Green's theorem. The results are applied to the calculation of diffraction of electromagnetic waves from a rectangular slit in a screen of infinite conductivity. The results are compared with an exact solution obtained recently by Morse and Rubenstein [see Abstract 249 (1939)]. AUTHORS.

3468. Reflection of Electromagnetic Waves in the Ionosphere. R. C. Majumdar. *Bose Research Inst. Calcutta, Trans.* 12. *pp.* 125–140, 1936–1937.—The conditions for the total reflection of electromagnetic waves in the ionosphere are examined directly from the definition that the total reflection takes place when the flow of energy associated with the wave vanishes across the wave front. It is found that the electromagnetic waves are totally reflected from a layer where either the refractive index vanishes or it becomes infinitely large. The critical penetration frequencies are worked out in general when the damping of the wave is not neglected. The Sellmeyer *vs.* Lorentz theory is also discussed in this connection. [See Abstract 2811 (1938).] AUTHOR.

3469. Simultaneous Ionosphere Observations at Washington, D.C., and Deal, New Jersey. J. P. Schafer and W. M. Goodall. *Terr. Mag.* 44. *pp.* 205–208, *June*, 1939.—This paper discusses the observations obtained during cooperative ionospheric tests made at Washington, D.C., by the National Bureau of Standards and at Deal, New Jersey, by the Bell Telephone Laboratories. Curves are presented which show that the critical-frequency values for the F- and F_2-regions were substantially the same at the two locations. Definite though small differences were noticeable during normal days, while during the violent phase of ionospheric storms the critical-frequency values for Deal decreased more rapidly and to lower values than those observed at Washington. AUTHORS.

3470. Electromagnetic Natural Oscillations of Dielectric Spaces. F. Borgnis. *Ann. d. Physik*, 35. 4. *pp.* 359–384, *June*, 1939.—The natural oscillations of dielectric spaces, which are limited on all sides by metallic conductors, are investigated by means of a method previously described by Bromwich [see Abstract 1332 (1919)]. Three cases are considered, where the boundaries are (1) right surfaces, (2) a cylinder with plane ends and (3) a sphere. The distribution of the electromagnetic field is determined in each case and the oscillation conditions belonging to the longest natural wave (fundamental) of the system are thoroughly discussed. The damping arising from eddy currents in the bounding surfaces is calculated to a first approximation, numerical values being given for a number of oscillation types. A. W.

See also Abstracts 3202, 3224, 3389, and

45B. Frequency Measurement. E. Fubini-Ghiron and P. Pontecorvo.
200B. Valve and Amplifier Theory. W. E. Benham.
497B. Direct Indicating Field Strength Meter. L. Rohde and F. Spies.
633B. Propagation of Radio Waves in an Isotropic Ionosphere .W. G. Baker.
634B. Anomaly in Propagation of Decametre Waves. L. B. de Clejoulx.
759B. Frequency Meter for Metre Waves. P. Gamet.
889B. Transmission Theory of Spherical Waves. S. A. Schelkunoff.
1724B. Relation of Radio Sky Wave Transmission to Ionosphere Measurements. N. Smith.
1727B. Field near Parabolic Reflector. W. Bach.

PHOTOELECTRICITY.

3471. Quantum Equivalent for Inner Photoelectric Effect. F. Hlučka. *Zeits. f. Physik*, 113. 1–2. *pp.* 56–60, 1939.—From a critical consideration of previous determinations of spectral yields by the primary inner photoelectric effect in diamond, zinc blende and rock-salt (made yellow by X-irradiation), together with results of additional measurements on zinc blende, it is argued that in all three cases a selective photoelectric effect occurs. The quantum equivalent condition is fulfilled only for a relatively small range near the maximum of the intensity curve. E. E. W.

***3472. Automatic Spectral-Sensitivity Curve Tracer. T. B. Perkins.** *J.O.S.A.* 29. *pp.* 226–234, *June*, 1939.—An automatic means for obtaining the spectral-sensitivity characteristics of photosensitive surfaces is described. The radiation from a W filament lamp is divided by means of a monchromator and used to excite the photosensitive surface. Compensation for the variable energy received at different portions of the spectrum (4000 to 12000 Å) is made by a special automatically controlled attenuator, so that the ordinates of the resultant curve may be expressed in response per unit energy. Compensation for the dispersion curve of the monochromator is made so that the abscissa may be calibrated in equal wave-lengths intervals. The design of a balanced modulator and high gain tuned amplifier necessary to obtain adequate deflection on the kathode-ray tube, on which the curve is traced, is discussed. The total spectral-sensitivity curve can be drawn by means of the automatic curve tracer in 30 sec. A 909–type kathode-ray oscillograph tube is used, so that the full curve can be seen for several minutes after the curve has been traced. AUTHOR.

3473. Photovoltaic Cells: Spectral Sensitivities of Cu, Ag and Au Electrodes in Solutions of Electrolytes. P. E. Clark and A. B. Garrett. *Am. Chem. Soc., J.* 61. *pp.* 1805–1810, *July*, 1939.—The spectral sensitivities of Cu, Ag and Au electrodes have been determined for a number of lines of monochromatic radiation ranging from 3650 to 6908 Å. The photovoltaic threshold values for these metal electrodes have been determined. The sensitivity of coated metal electrodes and some metal electrodes at 5461 Å is attributed to the coating on the electrode. A similarity in the mechanism of the photovoltaic and photoelectric effects is suggested from a comparison of the photoelectric threshold values of metals at various stages of outgassing and the photovoltaic threshold value. A vacuum tube circuit employing an F.P.–54 Pliotron tube is described as suitable for the measurement of photopotentials. AUTHORS.

3474. Selenium Photo-Cells. Part II. Current-Potential Relations. A. Becker. *Zeits. f. Physik*, 112. 11–12. *pp.* 629–647, 1939.—A systematic investigation was made of the current-potential relations of Se photo-cells under different conditions both as regards the incident light and the temperature. Current-potential diagrams are first given for normal temperature which show clearly the effect of the intensity of illumination and also of the wave-length. It is found that at the temperature of liquid air Se cells are photoelectrically sensitive only to light of long wave-length (red and infra-red). [See also Abstract 379 (1938).] A. W.

See also Abstract
1319B. Photoelectric Cell. C. Volpi.

THERMIONICS.

3475. Range and Validity of Field Current Equation. F. R. Abbott and J. E. Henderson. *Phys. Rev.* 56. *pp.* 113–118, *July* 1, 1939.—Field currents from cold kathodes under high vacuum conditions were investigated over a range from 10^{-17} to 10^{-5} A. Electrometer measurements of currents below 10^{-10} A showed no deviation from the empirical equation of Millikan and Lauritsen. Precise measurements in the higher range exhibited a consistent deviation from the Millikan and Lauritsen equation proportional to the fourth power of the field. This deviation is shown to be not necessarily in disagreement with the basis of the Fowler-Nordheim theoretical field current equation. AUTHORS.

***3476. Focused Beam Source of Hydrogen and Helium Ions. G. W. Scott, Jr.** *Phys. Rev.* 55. *pp.* 954–959, *May* 15, 1939.—An ion source of high intensity is described in which the ions are produced by bombarding a region of gas by a focused beam of electrons. This ion source is universal in that it may be used with any gas that may be ionised by electron impact. A theoretical expression for the emission from the ring-shaped kathode used in this source is given, and the emission *vs.* voltage curve calculated from this expression is compared with experimental emission curves. Electron beams as intense as $2 \cdot 2$ A/cm^2. are reported. Curves of total ion yield from the source plotted against (1) electron emission, (2) electron energy, (3) pressure are presented. H-ion beams of four mA are reported. The difficulty of focusing an ion beam of high intensity is discussed. A mass-spectroscopic analysis of H and He ion beams is presented. The proton yields vary from 5 to 80% of the total H-ion beam and are seen to be a function of pressure, electron energy and electron emission. The He^{++} yield in the He-ion beam is of the order of 5 % of the total beam current. [See Abstract 3065 (1939).] AUTHOR.

3477. Measurement of Intensity of Potassium Atomic Beams from an Incandescent Tungsten Surface. Part II. K. Kodera. *Chem. Soc. Japan, Bull.* 14. *pp.* 141–147, *May*, 1939. *In English.*—The following results have been obtained. (1) The ionisation efficiency of adsorbed K atoms by flashing is found to be in good agreement with the calculated one, if the correct values of the work function and those of the contact potential of the W surface are used. (2) Adsorbed K atoms begin to migrate on the surface of the ribbon when the latter is heated to 500–700° C. This effect enables a perfect ionisation to be obtained even with a concentration higher than $\theta = 0 \cdot 04$. (3) A simple method of determining the heat of activation of the surface migration is proposed. It is concluded that this method is the most suitable for measuring all at one time weak atomic beams of large cross-sections. [For Part I see Abstract 3064 (1939).] AUTHOR.

See also Abstracts 3383, 3389, 3395.

THERMOELECTRICITY.

See Abstracts

775B. Calculation of Temperature of Electrically Heated Wires. J. Fischer.
1601B. Wires Heated by Electric Currents. J. Fischer.
1629B. New Fuse Phenomenon. A. W. Metcalf.